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Shall the American Society of Civil Engineers Move Its Headquarters?

THIS week the Board of Direction of the American Society of Civil engineers sent out to its members a statement of a plan to transfer the headquarters of the society from its present home to the Engineering Societies' Building on West Thirty-ninth Street, New York City. The question, the board properly says, is one of the most momentous that has ever come before the society. The statement of the plan sent out does not take sides. It presents the subject dispassionately, leaving it to the members for discussion. The details will be found in the article on page 168 of this issue.

It is not possible in a single editorial to attempt a discussion of the question from every angle. The purpose here, therefore, will be to present the most important considerations, leaving for later issues such discussion of details and special phases of the question as may appear desirable.

First, let it be said that, in the opinion of this journal, it is scarcely possible to emphasize too strongly the importance of the subject. Thirteen years ago the same question was before the membership. The answer was in the negative. If the answer should now be the same, with the unsettled problems of thirteen years ago out of the way, it is morally certain that the proposal will never come again. If closer union in a physical way with the societies on Thirty-ninth Street is desirable, now is the time or never. Members of the society will need to appreciate the importance of the question and to give it the consideration it deserves.

The Engineering Record has for some years considered the advantages of a transfer of the society's headquarters. It is, therefore, and has been, prepared for such a discussion as has now been precipitated. First and foremost, it sees in the housing under one roof of all the great engineering societies, the external evidence of the final removal of the intangible, but nevertheless real, barrier which has existed between the American Society of Civil Engineers and its three sister societies. Gradually, year by year, that barrier has been yielding to the pressure of the need for closer co-operation. Many have been the steps toward better relations. Some of them are well known. First came the John Fritz Medal Board of Awards, then the organization of standing committees on inter-society co-operation, which considered, among other things, the standard bill for the licensing of engineers; then the establishment of the Engineering Foundation, and in turn the committees on the New York State Constitution and on a reserve corps of engineers. Each step has indicated the larger possibilities of a still better understanding, while movements outside the headquarters of the various societies have shown that the memberships and engineers at large appreciate more and more the need of closer relations if the engineer is to take his proper place in the nation's life. In St. Louis, in Philadelphia, in Boston, in cities the country over, local clubs and societies, having in their membership engineers of every complexion, have been growing to power and have been bringing about an affiliation between the local branches of the national organizations. The movement has been irresistible. Papers read before many of the local bodies, in the last two years in particular, have pivoted about the status of the engineer and the means for its improvement. The renewed proposal of assembling the four great national bodies under one roof comes, therefore, as a climax of a great movement that has strength the country over; and those who have argued for closer co-operation, those who have discussed ways and means of improving the status of the profession, will be able to reach no other conclusion than that the movement under discussion is right, that the four bodies should be housed together just as soon as possible.

But while the logic of the growing activities of the past few years forces one to the conclusion that the suggested change is desirable, one naturally inquires as to the definite advantages in sight and also as to the offsetting disadvantages, if any.

The paramount advantage is the closer spiritual relationship between the four national bodies which will inevitably flow from the closer physical relationship of their headquarters. The secretaries of the societies, forming the managing committee of the building, get together daily and naturally interchange information as to the activities of their various organizations. Co-operation under such a plan is inevitable, as the history of the three bodies now on Thirty-ninth Street has shown. They have been called upon to advise the national government and congressional committees in cases where it is unlikely that any of them singly would have been drafted for such an important public duty. Moreover, committees with kindred interests and representing the various societies, meeting simultaneously under one roof, have been able very effectively to co-operate. The mere advantage of a broader inter-society acquaintanceship would alone almost warrant the change in headquarters, for that wider acquaintanceship, breeding confidence in sister societies, strengthens the individuals in their work for better recognition of the engineer and of his representative professional organizations. Without doubt, too, the relations at headquarters will be a stimulus for a very rapid spread of the affiliation idea between local branches, a movement which has already had a most favorable influence upon local public matters of an engineering character. The housing under one roof would be, as it were, the "outward sign of an inward grace" that would declare to the country at large that all engineers were standing together and that in any movement for the good of the profession and of the public, the virile support of 30,000 engineers could be relied upon. As long as one of the societies holds aloof in a physical way, this impression of solidarity cannot be carried to the public mind, and the profession is bound to be the loser.

Taking another phase of the movement, one finds in the possibilities of making a great engineering library an advantage in which the spiritual is mingled with the material. Here the consolidation of the books and manuscripts will be the means of strengthening the spiritual life of the organizations, enabling them to serve better their ever-increasing memberships.

From the physical standpoint the advantages, it seems to the Engineering Record, are distinctly on the side of the Thirty-ninth Street house. It has an adequate auditorium and meeting rooms of various sizes. Its location, midway between the Pennsylvania and the New York Central stations, in the midst of the hotel and club district, a section which is ever increasing in the advantages of its transportation facilities, cannot be excelled. The Fifty-seventh Street property, on the other hand, is in a neighborhood which is on the decline, at least from the standpoint of such a purpose as the headquarters of a national engineering society. Commercial interests which do not make for the peace and quiet desirable for a building such as the society's home have made large inroads in the neighborhood.

As to the disadvantages of the change, the Engineering Record sees few, if any. The chief argument it has heard advanced against the proposal is that the society would lose its identity. While the Engineering Record has the greatest respect for those who take such a position on account of their great pride in the standing of the American Society of Civil Engineers and their desire to see it maintain its present eminent place among engineering bodies, it does believe that their fears are groundless and that they do not consider correctly the status under which the society would make the change.

If the society continues its present good work and expands it, as it should and must do, there is little likelihood that it will be submerged and that its place will become less definite in the minds of engineers or of the country at large. This journal believes, on the contrary, that all of the societies will be strengthened by the closer union.

Moreover, the American Society of Civil Engineers would go into the Engineering Societies' Building to occupy physical headquarters, not changing its form of management, not giving up its publications, its committee system or anything it holds at present, except the building in which it is housed. True, there would be lost what sense of individuality comes from occupying a separate building, but that feature is minor compared to the society's technical prestige, and may well be sacrificed for the greater good that would come from the external evidence of professional solidarity.

As to the details of the proposal made by the United Engineering Society, both plans appear to this journal to be eminently fair. They would give the American Society of Civil Engineers an equity of about $500,000 for a consideration of $250,000 in cash, at the same time leaving the society in an exceedingly strong financial position, with approximately $100,000 of liquid funds in its treasury.

It is apparent from the trend of this discussion that the Engineering Record favors the removal to the United Societies' Building. The advantages in spiritual and material ways are so palpable, in its judgment, that an affirmative decision should result. The demand for the better recognition of the engineer, for fuller participation by him in the nation's life, is so insistent that it is difficult to see how a plan which will go far toward the consummation of all that it is desired can well be rejected. The issue at stake is a great one. At a single stroke the engineers of the country can stand before the public at large as a united army of 30,000. If the civil engineers refuse to accept the opportunity the present unfortunate division—for, whether we will it or no, the separation of headquarters has erected a barrier—will continue. This journal most earnestly hopes that its readers will favor the proposed plan. Realizing, however, that there are those who will dissent, it gladly opens its columns for a full discussion.

State Regulation from a New Angle

MANY who have turned a deaf ear to what they have deemed the hard-luck stories of the railroads concerning the burdens of dual regulation might get a new viewpoint from the address, abstracted on page 178, of Alfred P. Thom before the Second Pan-American Scientific Congress. Mr. Thom pointed out that every state reached by an interstate railroad is affected by regulation imposed on that road by one state, and that one state, by a selfish or narrow policy, may impose hardships on ten others reached by one trunk line. In his estimation, also, the European War has an important bearing on the matter, as it shows the imperative need for national and uniform industrial efficiency, not halted at state lines. Mr. Thom has presented his case so well, however, that to do more than call attention to his argument would be superfluous.

The "Touch of Elbow"

IN another column the significance of the recently organized plan of military training for New York engineers is discussed. Apart from the aspects of this movement which relate purely to adequate national defense one phase is bound to assume immense importance. There is nothing like a common object for bringing men of different types together. In any great concerted effort toward a single goal conceit and petty jealousies are soon forgotten, rough edges of personal differences of opinion are rounded by close contact, and conflicting ideas are cast into a melting pot. At the engineering training camp in Plattsburg next summer civil, electrical, mining and mechanical engineers of all degrees will rub elbows. It would be difficult to conceive of a project which could do more to weld the professional interests of these men into a closer bond than the life together out in the open. Flannel shirts and khaki are great levelers. In the ranks the members of the engineering profession will feel the "touch of elbow"—the contact of man against men which means team-work—and an esprit de corps will be developed which will continue after the men return to their professional work. That a desire for closer association of engineering interests exists was never more apparent than at present. Its latest manifestation, reported elsewhere in this issue, is the invitation of the United Engineering Society asking the American Society of Civil Engineers to become one of the founder members of the united organization and to move its quarters to the Engineering Societies' Building, thus bringing the four national engineering organizations into intimate relationship under one roof. Certainly the engineering camp is bound to foster the much-sought spirit of brotherhood among members of the battalion. The men who serve will return to New York with something more than a knowledge of an engineer officer's duties. The "touch of elbow" spirit cannot be left behind within the camp borders.

Future of Our Export Trade

THE foreign trade convention in New Orleans last week was widely heralded as one of the most important conferences of business interests the country has known. It deserved the characterization given it, and could its message be carried to the common people, to the voters of the country, the response would be such that foreign trade would overnight be given a new status in the thought of the country and Congress would be forced to remove the handicaps now embarrassing export business. Manifestly, it is impossible to bring that message to the people at large, for the relation between foreign trade and their personal interests is not self-evident. Relief must be sought, therefore, through the influence of the more enlightened citizens upon their representatives in Congress.

The basis for the strong movement for foreign trade expansion is its stabilizing influence on industry. The plant with a goodly share of its products sold abroad is the one that is likely to be kept running despite conditions here; in that lies the influence of foreign trade upon the welfare of each citizen.

A larger foreign trade then is desirable. But when ways and means of getting it are considered, one realizes that very grave obstacles confront manufacturers contemplating overseas business. To some extent the government helps in foreign trade extension—through its consular and commercial attache services. But that aid is more than negatived by the legal restrictions which Congress has seen fit to impose.

There are three principal agencies by which foreign trade expansion will be had—by increasing our investment in foreign lands and establishing our own banks there; by the co-operation of manufacturers, whether competing or not, in all matters affecting foreign trade; and by the development of a merchant marine. In each of these directions there is hampering legislation. The federal reserve act forbids banks which are members of the system combining with other banks, even if the combination be solely for the establishment of new institutions in foreign lands. The anti-trust laws prevent co-operation among competing manufacturers, though the object be merely to make their work in the foreign field more effective, while the seamen's bill, as is well known, is rapidly driving what little American shipping there is from the seas. The disappearance of our shipping in the Pacific, as a result of the La Follette bill, is bitter evidence of the lack of co-operation between the government and those who desire to develop export trade.

In some directions relief seems to be in sight. Joseph E. Davies, chairman of the Federal Trade Commission, stated emphatically at the dinner held in connection with the foreign trade convention that his commission stood ready to advocate the amendment of the anti-trust laws so that they will not apply to foreign trade, while a bill will shortly be introduced in Congress amending the federal reserve act so as to allow American banks which are members of the system to subscribe to the stock of banks organized for the foreign field. As to the merchant marine, however, there is no silver lining to the present black cloud. The administration is fighting for government-owned ships, confident that shipping interests will be glad to lease them. That seems to be a futile hope, for the decadence of American shipping is due primarily to high operating cost and not to high first cost, though the latter has always been a serious factor. The merchant-marine situation can be improved only by repealing the present seamen's act.

Apparently the subject is one in which all intelligent citizens should take a lively interest. The mass of the people are not likely to think correctly on the subject, being misled by agitators and occupied with interests which seem to them to affect their welfare more immediately. A practicable means of bringing about improvement is to force Congress to realize that the situation is serious and that the remedies lie solely in its hands.

Getting Down to Real Work in Preparedness

EVER since General Leonard Wood, in his memorable address before the Brooklyn Engineers' Club on Dec. 2, aroused engineers to a realization of their place in the general plan for national defense, the demand among the technical men of New York for further knowledge of the engineer officers' duties has been widespread. Up to the present time interest has manifested itself chiefly in individual efforts to get action. Several local engineering organizations appointed committees to report upon ways and means of enhancing the military value of their membership. As the movement expanded, however, it became evident that these commendable efforts would soon be working at cross purposes unless they were co-ordinated and directed by some central agency. There was power and enthusiasm, but no organization of a comprehensive character. The engineers were quick to appreciate this fact, and numerous conferences of all the interests involved have now welded the several plans into a single harmonious project for engineers in New York City and its vicinity, to be carried out under the auspices of the four national engineering organizations—civil, mechanical, electrical, and mining.

As the first definite move in the campaign a course of seven lectures has been arranged, as announced in the news section this week. They will be held in the auditorium of the Engineering Societies Building. General Wood will have general direction of the meetings and the speakers, in addition to him, are Captains Robins, Coiner and Ardery, all of the Corps of Engineers, U. S. Army. For the present there will be no military drill. The idea, apparently, is first to give the profession a bird's-eye view of the scope of the military engineer's duties in the field. Having this picture in mind the engineer can then undertake field work intelligently. The lectures are essentially a preliminary to service next summer at a camp in Plattsburg. Thus there will be an opportunity of putting theory into practice. Every military authority emphasizes the fact that the engineer officer must be a soldier first of all. Attendance at lectures is, of course, desirable, but it must be backed up by field service if the full value of the instruction is to be realized. Now is the time for engineers to enroll for the course and the camp to be held in Plattsburg next summer.

Following upon the heels of President Wilson's recent selection of the engineering profession to undertake an industrial census of the country's military resources, the organization of the New York training course and camp for technical men is highly significant. It indicates one thing clearly—that in the military preparedness program engineers can be relied upon for action, rather than talk. This is what counts. The country is already surfeited with plans and suggestions relating to military preparedness. It is now time to get down to real work. This is what the technical men of New York have done.

State Commissions' Views on Federal Valuation

HAD the state commissions at the valuation conference in Washington last week, an account of which appears in the "News of the Week," made Mr. Thelen of California their sole spokesman it seems to this journal they would have presented a much stronger case. With much that he said the Engineering Record agrees, and it believes that the discrepancy between his views on these points and those of the railroads is more apparent than real. Some of his theories the Engineering Record regards as unsound, but even these Mr. Thelen presented with a dexterity that almost made them plausible. Especially adroit was his summing up, in which he selected such of the views of his associates as he could indorse, and wove them into a well-rounded argument that seemed to be the unanimous view of all of the states.

On the other hand the comments and queries of some of the federal commissioners and attachés on theories expounded by the other state commissioners suggest that the latter overstepped themselves and really strengthened the railroad cause by clinging to untenable views. The Interstate Commerce Commission will hardly be impressed with Judge Helm's fear that because the state commissions are not competent to hold their own in argument with the railroad organization the national body must be on its guard. Having recognized and urged on the railroads the necessity for co-operation to make the valuations complete and reliable, the federal board will hardly applaud Judge Helm's plea that the railroads should withdraw and let the government do its best alone. Neither is it likely to see the fairness and desirability of dropping the work rather than let totals come to light far in excess of what the states approve. The national commission would hardly be satisfied with the state commissions' dictum that the state commissions interpret depreciation correctly, as so painstakingly set forth by Mr. Niles, even if the decisions cited were in absolute accord; much less as they were not. Director Prouty readily perceived the impracticability of attempting to allocate investment from earnings as argued for by Mr. Aitchison. The national commission will as readily perceive the absurdity of the Minnesota theory of instantaneous reproduction, even though it was set forth less baldly in the oral argument than in the Minnesota brief. And it will refuse to be beguiled by Judge Helm's failure to differentiate between land acquired by condemnation and that held in fee simple.

Reverting now to the main arguments—those of Mr. Thelen—this journal disagrees absolutely with Mr. Thelen's view on land. In the California commission's Mojave & Owenyo finding, quoted from at the conference and previously quoted from in the Engineering Record of Jan. 15, page 76, a reproduction figure for land but 66 per cent of the actual cost was found, and this in the face of an apparent general increase in surrounding land values. Surely there can be no charge of conjecture here in the figure rejected by the commission. The commission seems to be standing squarely on a technicality. The commission, which in most respects shows a disposition of fairness toward the utilities conspicuously lacking in some other state commissions, admits that railroad land could not be replaced at market value, but holds that the Minnesota rate decision bars anything else. This journal holds that as soon as the Supreme Court is shown clearly that market prices will not buy railroad land, it will upset these theories based on the Minnesota case.

Mr. Thelen refuses to take seriously the railroads' "other elements of value," save, of course, development expense. As pertinent to the main rate problem, whether rates in general are too high or too low, so does the Engineering Record. Nevertheless they exist, as all agree, hence the Valuation Act requires that they be found—if only for taxation purposes! And Mr. Thelen's own comments on the Ocean Shore Railway case suggest that perhaps he would give the intangibles more weight than the railroads themselves, so much weight that all cost figures would shrink to insignificance and the value of the service would become the sole criterion. Truly this question of intangibles, and whether the rate fixes the value or the value fixes the rate, is in a chaotic state.

The agitation about whether or not the Interstate Commerce Commission should make a finding of ultimate value seems like a tempest in a teapot. Does it matter whether the commission produces a total in which the items are all shown, so that they may be analyzed and modified as the particular case demands, or present the list of items and a comptometer, so that Congress or the courts can do the adding? A total would give all concerned some immediate conception of the value of the property. But none of those concerned would accept that total as the be-all-and-end-all for every purpose, especially as it would require constant revising, as will the items that would make it up.

In conclusion, the view of the states appears to be that, while they read into court decisions that reproduction cost is thoroughly discredited, they are not so sure of their ground but that they are determined to use their best efforts to keep that reproduction cost, which, when taken rationally, allows the so-called unearned increment, down to original cost, which does not. The trouble is that they follow different processes of reasoning in whittling down the real cost of reproduction, and some of those processes have collided squarely, with great damage to the cause. The Engineering Record has no fear that the Interstate Commerce Commission will be misled. Agreeing with Mr. Thelen that many of the legal questions of valuation are yet unsettled, it believes the commission will recognize the eligibility of reproduction cost as a basis of value to be one of them.

Shall Civil Engineers Move Their Headquarters?

Momentous Question of Relinquishing Society House and Moving to Engineering Societies' Building Is Submitted to Membership for Vote—Movement Springs from Desire for Broad Co-operation

MEMBERS of the American Society of Civil Engineers are on the eve of a decision characterized by the Board of Direction as the most momentous in the history of the organization. Through a letter ballot, distributed this week, and to be counted June 15, a vote will be taken upon the acceptance or rejection of a proposal to relinquish the $325,000 house and land at 220 West Fifty-seventh Street, New York City, and transfer the society's headquarters to the Engineering Societies' Building, erected in 1907 as a result of Andrew Carnegie's donation of $1,050,000 for an imposing structure to assemble under one roof the country's national engineering organizations. The Board of Direction's action in submitting the question to ballot is the outgrowth of an invitation in which the United Engineering Society, comprising the national electrical, mechanical and mining bodies, asks the civil engineers to consider joining the united organization as a founder society. It will be recalled that the electrical, mechanical and mining engineers entered into the project financed by Mr. Carnegie in 1903, but that the civil engineers decided at that time to remain in their present quarters on West Fifty-seventh Street, which they had built and owned. In sending out the letter ballot the Board of Direction of the American Society of Civil Engineers points out the present need of closer co-operation among all members of the engineering profession, stating also that one of the purposes of the projected movement is to strengthen the bonds of brotherhood which should exist among all engineers.

BOARD OF DIRECTION'S COMMUNICATION TO CIVIL ENGINEERS

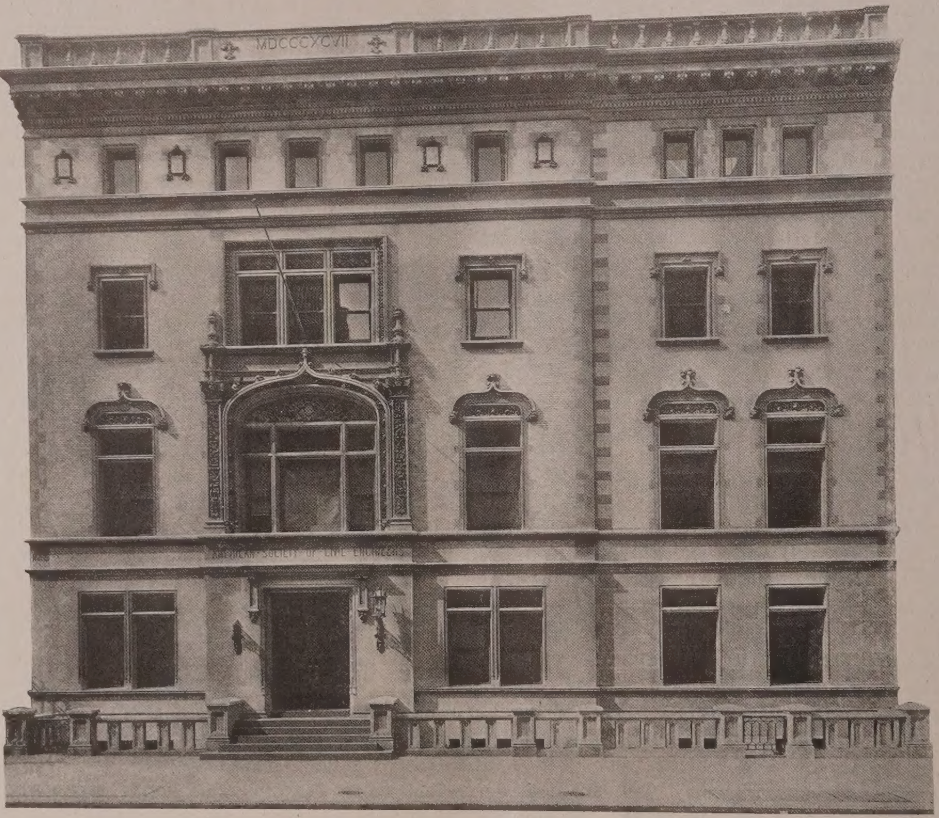
The communication from the Board of Direction of the American Society of Civil Engineers to the membership is reproduced, in its more important parts, below:

An offer has been made to this society which your board considers to be one, the acceptance or rejection of which is perhaps the most important question which has ever come before the society. It will be remembered that 12 years ago by a letter ballot the corporate members of the society decided not to accept, in its behalf, a quarter interest in the gift of Andrew Carnegie of $1,050,000 to be expended on a home for the four national societies. Subsequent to this decision Mr. Carnegie gave the amount mentioned to the three other societies, and at No. 29 West Thirty-ninth Street there was erected a thirteen-story building for their occupancy. This money was expended entirely upon the building, the land on which it was built being furnished by the three societies.

In 1896 this society purchased two lots on West Fifty-seventh Street and erected its own home, and, subsequent to the decision not to accept Mr. Carnegie's offer, purchased an additional lot and erected an addition to the original building thereon, so that the present home of the society consists of a four-story and basement building of 75 ft. frontage, and an average depth of 110 ft. 7 in.

NEED GREATER CO-OPERATION

The advisability, even the necessity, of greater co-operation among the various branches of the engineering profession for the general good has been a frequent topic of discussion for the last few years. One of these discussions resulted in an informal meeting of a number of gentlemen interested in this subject on June 9, 1915—the American Institute of Mining Engineers, the president-elect of the American Institute of Electrical Engineers, a past-president of the American Society of Mechanical Engineers, and the secretary of the American Society of Civil Engineers.



VOTE WILL DETERMINE WHETHER OR NOT THIS HOUSE WILL BE RETAINED AS HEADQUARTERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Following this conference, Gano Dunn, president of the United Engineering Society, extended to the American Society of Civil Engineers on June 24, 1915, an invitation to become one of the founder members of the united organization. He also announced the appointment of a conference committee consisting of Charles F. Rand, chairman, Dr. Alexander C. Humphreys and H. H. Barnes, Jr.

The United Engineering Society was incorporated for the purpose of acting for the three founder societies, viz.: the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, in all matters relating to their property holdings. Moreover, this original suggestion and the subsequent offer made by the United Engineering Society acting for these three founder societies have been referred to and confirmed by each of the societies separately.

CIVIL ENGINEERS APPOINT COMMITTEE

A conference committee for the American Society of Civil Engineers, consisting of Vice-President Clemens Herschel, Past-Director Robert Ridgway, and Secretary Charles Warren Hunt, was appointed by President Marx, and after careful investigation of the whole question, reported to the board Sept. 20, 1915. At a meeting of the board Nov. 9, 1915, the committee was enlarged by the addition of Vice-President Charles F. Loweth and Past-Presidents John A. Ockerson, George F. Swain, and Hunter McDonald. This committee has been going into the whole matter thoroughly, and has been furnished by the committee of the United Engineering Society with all available data upon which a judgment of the situation, so far as business arrangements are concerned, must be based. The present communication is based on the unanimous report of that committee.

ALTERNATIVE OFFERS

There have been two offers made which may be briefly stated as follows:

(A) That a two and one-half story addition be made to the United Engineering Society Building at a cost estimated at $225,000, and not to exceed $250,000. That the American Society of Civil Engineers shall pay for this addition if the cost does not exceed the latter figure, and if said cost does exceed $250,000, the additional expense shall be borne by the United Engineering Society.

That the American Society of Civil Engineers shall then become an equal owner in the whole enlarged property on the same terms as each of the three present founder societies, and occupy as much space as it may need on the two floors to be added.

(B) That the American Society of Civil Engineers become one of the founder societies by the payment into the United Engineering Society treasury of a sum of money equal to that which each of the three founder societies has paid, the estimated amount being $240,000. This sum to be invested in interest-bearing bonds and held for the benefit of the United Engineering Society, of which the American Society of Civil Engineers would then become a part. That these bonds would be available in case it should later be found necessary to enlarge the building; otherwise, the income would be available for the activities of the United Engineering Society as the founders may determine. The American Society of Civil Engineers to occupy such part of the sixth and seventh floors as it needs. (See Appendix B.)

CONDITIONS OF ALTERNATIVES

The property of the United Engineering Society now stands free and clear of all debt, and there is a reserve fund of $70,160.89 for amortization of the building and for depreciation and repairs, and if the first offer is accepted this society will have an equal ownership in the entire enlarged property with the three other societies for practically the same amount of cash which each of them has expended up to the present time.

It will be observed that if offer A is accepted the present building will be enlarged so as to accommodate in a large and up-to-date stack-room the proposed great research library in addition to providing enough additional space for the use of our society on the two top floors, thus leaving plenty of room for the accommodation of other smaller scientific and technical organizations, many of which now occupy space in the building.

If offer B is accepted many of these present occupants will necessarily have to seek other quarters, and, as the work of the four societies grows, eventually there will be room only for the four founder societies. It is true that the proposed addition may be made when necessary, but in the meantime the building will have lost the character of a headquarters for all professional activities, and will be only the home of the four founder societies.

It is evident, therefore, that the acceptance of offer A will carry out more fully the broad fundamental idea which underlies the whole proposal.

There can be no question as to the ability of the four societies to handle the larger of the two propositions from the beginning.

VALUE OF PROPERTY

In order to ascertain from a reliable source what quick assets the society may have with which to operate, a valuation of the present property of the American Society of Civil Engineers was made by the Real Estate Board of New York, as follows: Value of land, $290,000; value of building, $35,000; total valuation, $325,000.

It will be noticed that in this report the present value of the ground on which the society house is built is given as $290,000. Its total cost to the society, including legal fees, etc., was $185,406.20. Attention is called to the fact that the cost of the building, including legal expenses, etc., has been $174,775.64, and that its estimated value by the Real Estate Board of New York is only $35,000. Adding the cost of the land to the cost of the building, the total cost of the society's real property at the present time has been $360,181.84, and it is only proper to say that the present house of the society is, in the opinion of many members, adequate for its present needs, and could not be duplicated at the present date at the figures given. In other words, that the society could not at the present date duplicate its plant for less than $475,000.

ENGINEERING SOCIETIES BUILDING IN NEW YORK —VOTE WILL DECIDE WHETHER OR NOT AMERICAN SOCIETY OF CIVIL ENGINEERS WILL MAKE PORTION OF THIS STRUCTURE THEIR NEW HOME

Assuming, however, that the property could not be sold quickly at more than the amount named by the Real Estate Board, and adding the amount which the society now has invested in bonds over and above the amount of the present mortgage, it would appear that a very conservative estimate of the available assets which could promptly be turned into cash is $365,000. ($90,000 is now invested in bonds and the present mortgage indebtedness is $50,000.) Should the society, therefore, accept offer A it could make full payment and have between $115,000 and $140,000 in the treasury, and would then own a one-quarter interest in the enlarged property of the United Engineering Society, the cost of which added to the accumulated reserve fund already mentioned will amount to $1,967,332, one-quarter of which is $491,833.

A careful investigation of the cost of operation and maintenance at the present home of the society, and for an equal accommodation in the Thirty-ninth Street building, shows that this item need not be considered, there being no material difference in the annual cost of operation.

Your board also wishes to suggest that, as there would be no great haste about selling the property of the society, a sum considerably more than that estimated by the New York Real Estate Board may be secured.

GREAT LIBRARY POSSIBLE

The libraries of the three founder societies, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, are now combined, and are being operated by the United Engineering Society, and the addition of the library of the American Society of Civil Engineers would result in a collection of engineering books aggregating approximately 150,000 volumes. This would form the nucleus for one of the greatest technical libraries of the world, which, when properly housed, catalogued and maintained, would furnish an equipment for the carrying on of research work which could not be excelled. There is reason to believe that should such a combination be formed, funds to a large amount would be forthcoming for the endowment and maintenance of such a research library.

CLOSER CO-OPERATION NEEDED

For a number of years it has been quite evident to those who have been close to the activities of engineering societies that a closer co-operation is needed especially along the lines of the general welfare of the profession. Matters have come up from time to time which have resulted in the appointment of a joint committee (which is now in existence) to consider and to report back to the governing bodies of each of the societies on any question brought to its attention which affects the profession as a whole, and joint committees of all the societies have also done much work in matters relating to proposed legislation in various states on the licensing or registration of engineers, and in connection with the work of the recent constitutional convention of the State of New York. In addition to this all four of these national societies have been represented for more than nine years on the John Fritz Medal board of award, and they are now all equally represented on the Engineering Foundation Board, which was founded by the generous gift of Ambrose Swasey. It is largely through such joint committees made up of members of each society, clothed with the proper authority, that the general welfare of the engineering profession can be safeguarded and promoted.

It is the belief of your board, after repeated conferences with the officers and conference committee of the United Engineering Society, that such committees, which now must be more or less disjointed in their action, may be made more permanent, and therefore represent more authoritatively the engineering profession in matters relating to the status of the profession generally, and its individual members, both financially and socially, and in a manner which it is not possible for any one purely professional organization to accomplish. The need for such authoritative representation is clearly indicated by the attitude of many members of our society, as well as of the other national organizations.

STRENGTHEN BONDS OF BROTHERHOOD

The engineering profession needs coöperation along these lines, there being no coherence between individuals, or groups of individuals, and it is one of the purposes of this movement to strengthen the bonds of brotherhood which should exist between all engineers.

It is fully recognized that to accomplish anything of magnitude sacrifices often must be made, and that to a certain extent, at least so far as property ownership is concerned, our society, if the offer is accepted, will give up a certain amount of independence. This does not, however, go any further than the property consideration, as it is not proposed in any way to change the methods of control of each individual society. Closer association with men of similar training, though working along the lines of different specialties, should tend to broaden the views of those who come within the sphere of such influence.

Our society now has a fine home, adequate, in the opinion of many members, for its present needs, and, as they think, capable of such enlargement as may be rendered necessary during the next 15 or 20 years. On the other hand, if the proposed enlargement of the Engineering Societies' Building is carried out, there will be plenty of room for the four founder societies, and for a large number of other organizations not strong enough to own their own headquarters, and thus there will be in the city of New York a representative American engineering headquarters where any engineer may go with the certainty of meeting his professional brothers.

In such a project as this there are many details to be considered, and while much study has been given to the whole question by your board, in its execution there will doubtless be many matters of adjustment which cannot be foreseen.

The main question, however, which must be decided by the membership of the society is whether the offer of the United Engineering Society shall be accepted. Members who are in favor of entering the united society are asked to indicate their preference for either plan A or plan B, or whether they prefer to leave the matter to the Board of Direction.

Am. Soc. C. E. House the First Engineering Society Building in America

Four-Story Structure in New York City Was Opened in 1897 and Subsequently Enlarged to Add 50 Per Cent to Its Capacity

THE house of the American Society of Civil Engineers at 220 West Fifty-seventh Street, New York City, which will be given up if the vote of the membership on the recently issued letter ballot is in favor of moving to the Engineering Societies' Building, 29 West Thirty-ninth Street, where the national organizations of electrical, mining and mechanical engineers are housed, was the first structure in the United States built solely for the use of a professional engineering society. As originally designed it was a four-story building with a 50-ft. frontage and a depth of about 111 ft. It was completed and formally opened Nov. 24, 1897. About eight years later, on account of the rapid growth of the society's membership, it became necessary to make an addition to the building, on the west side, which added about 50 per cent to its capacity and increased its frontage to 75 ft. In architectural treatment and general interior arrangement the addition was along the same lines as the original structure. The following notes, therefore, will deal with the society house before it was enlarged.

PROJECT INAUGURATED IN 1895

The project for the building was inaugurated in 1895. Careful estimates of the resources of the society were made and the question was referred to the business meeting of the annual convention which was held in June of that year near Boston. This meeting approved the project unanimously and the whole matter was placed in the hands of the Board of Direction, with power. A building committee was appointed Jan. 15, 1896, and served continuously until the house was completed and final payment made to the architect and builder. This committee consisted of George A. Just, chairman; Charles Warren Hunt, Joseph M. Knap, Charles Sooysmith, Thomas C. Clarke, William R. Hutton, Bernard R. Green and George H. Browne.

The dedicatory exercises in 1897 were presided over by B. M. Harrod, president of the society. Addresses were delivered by President Harrod, Gen. William D. Craighill, past-president; J. G. Schurman, president of Cornell University, and the Hon. Joseph H. Choate. In the evening there was a housewarming at which about 700 were present.

ARRANGEMENT OF BUILDING

On entering the building one passes through the vestibule into a main hallway and foyer. On the left is a coat room and a reception room and on the right the secretary's offices. The hallway leads to a large lounging room underneath the auditorium. This room runs the full width of the building and serves as a gathering place for members after the regular meetings. It is connected with a serving room for the collations which are served after the regular meetings. This room also is the scene of the society's annual smoker. At the left of the main hallway is a stairway ending in a central hall on the second floor, which is given over to the reading room and the auditorium. The reading room occupies the second story front of the house, faces north and contains the latest files of all periodicals, publications of technical societies and in short all current engineering literature. There are also shelves where new books are placed for a short period after they are received. A section also is devoted permanently to such volumes as are often consulted—engineering hand-books, technical dictionaries, encyclopedias and the like. The reading room is open every day except Sundays and certain holidays from 9 a. m. to 10 p. m. and librarians are on duty to assist those consulting the general card index. Books are brought from the stack room on the fourth floor to the reader.

CONTENTS OF LIBRARY

The auditorium occupies the entire width of the house and its depth beyond the hallway leading to the library. In this room are held the regular meetings of the society at which technical papers are presented and other business transacted. The third floor is devoted entirely to executive and editorial work while the fourth floor is occupied by the stack room. The contents of the library, as given in Secretary Hunt's latest annual report was as follows: Bound volumes, 25,872; unbound volumes, 48,452; specifications, 7869; maps, photographs and drawings, 5236; total 87,429.

The work of the society makes it necessary to provide a large amount of storage room and this is secured in the basement, where quarters for the janitor also are provided. The boiler room, coal bin and engine room were located in a vault under the sidewalk entirely separate from the building. The engine room of the original building contained two gas engines of 25 hp. each with direct connected dynamos furnishing current for lighting of the building. Heat was supplied from a low pressure boiler. The entire house, with the exception of the board room and auditorium, was heated by direct radiation while in the two rooms mentioned the indirect method was used.

Since the enlargement of the society house was made in 1905, there has, of course, been a certain rearrangement of the interior. The auditorium has been enlarged and a board room provided on the second floor joining the library. The general meeting room on the ground floor also has been extended westward the full width of the building. The general appearance of the exterior of the house, including the addition is shown in the photograph on page 168.

The society's property has shown a steady appreciation in value from year to year. A recent appraisal by the Real Estate Board of New York gives the value of the enlarged building and plot as follows: Land, $290,000; building, $35,000; total valuation, $325,000.

Engineering Societies' Building the Home of Three National Organizations

Thirteen-Story Structure Made Possible by Andrew Carnegie's Contribution of $1,500,000 in 1903 to Unite Technical Bodies Under One Roof

THROUGH the generosity of Andrew Carnegie, who, in 1903 contributed $1,500,000, for the purpose, it was possible to erect the Engineering Societies' Building at 29 West Thirty-ninth Street, New York City, to which the American Society of

Civil Engineers may move its quarters if the membership decides to relinquish its present house on West Fifty-seventh Street. The Engineering Societies' Building is now the headquarters of the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, known as the three founder societies, and a score of other kindred engineering and scientific organizations. When the project was considered the American Society of Civil Engineers was invited to join in the plan, but inasmuch as it had a house of its own and was then in a flourishing financial condition it decided not to accept this offer.

AN IMPOSING STRUCTURE

The Engineering Societies' Building was completed and opened in 1907. It is thirteen and one-half stories high and has a frontage of 115 ft. and a depth of 90 ft. The exterior is of limestone up to the auditorium floor and above is of gray mottled brick and terra cotta. The main entrance foyer is laid with Tennessee marble and the central court is marked by twelve large marble columns. The wood work is dark oak. On the ground floor is the office of the superintendent of the building, a committee room, telephone booths and a ladies' reception room. On the mezzanine floor below the first floor are several dressing booths and lavatories for the convenience of members. On the second floor is the coat room.

The main auditorium, one of the features of the structure, extends up through the third and fourth floors and seats about 1000. On the fifth floor are two large lecture halls; on the sixth floor a lecture hall and society offices; on the seventh and eighth floors the headquarters of the associated societies; on the ninth floor the headquarters of the American Institute of Mining Engineers; on the tenth floor the headquarters of the American Institute of Electrical Engineers; on the eleventh floor the headquarters of the American Society of Mechanical Engineers. The twelfth floor is used as a stack room for the library and also contains a small meeting room. The library proper occupies the thirteenth floor.

The main auditorium was arranged primarily for meetings of societies at which the speaking is from the floor as well as from the platform and where diagrams, illustrations and blackboard drawings are often employed. Particular attention was given to its seating arrangements and to its acoustic properties. On both the main floor and the gallery, at the sides, the auditorium is surrounded by corridors rendering easy access to every point and permitting ready withdrawal for conversation or conferences.

On the fifth floor are three assembly rooms seating respectively 500, 250 and 100 persons. On the sixth floor is an assembly room seating 150. The plans of all halls were submitted to and approved by Prof. W. C. Sabine, of Harvard University, an expert on acoustics. The principal feature in the plan of the building is the reservation of the twelfth and thirteenth floors for the libraries of the three founder societies. The founder societies entertain the ambition to create and maintain the finest collection of engineering literature in the world, supplemented by the current periodicals and patent literature relating to inventions in the arts and sciences.

The basement is occupied in part by the boiler room, 22 ft. below the curb and the engine room 16 ft. below. Steam is employed for heating and for tempering the air used for ventilating purposes. A thoroughly modern and effective ventilating system is provided for the lower floors of the building which contain the large assembly rooms. Special and unique features were adopted in the building construction so as to introduce the air into and exhaust it from rooms by a great number of openings at a low velocity, thus securing a perfect air distribution.

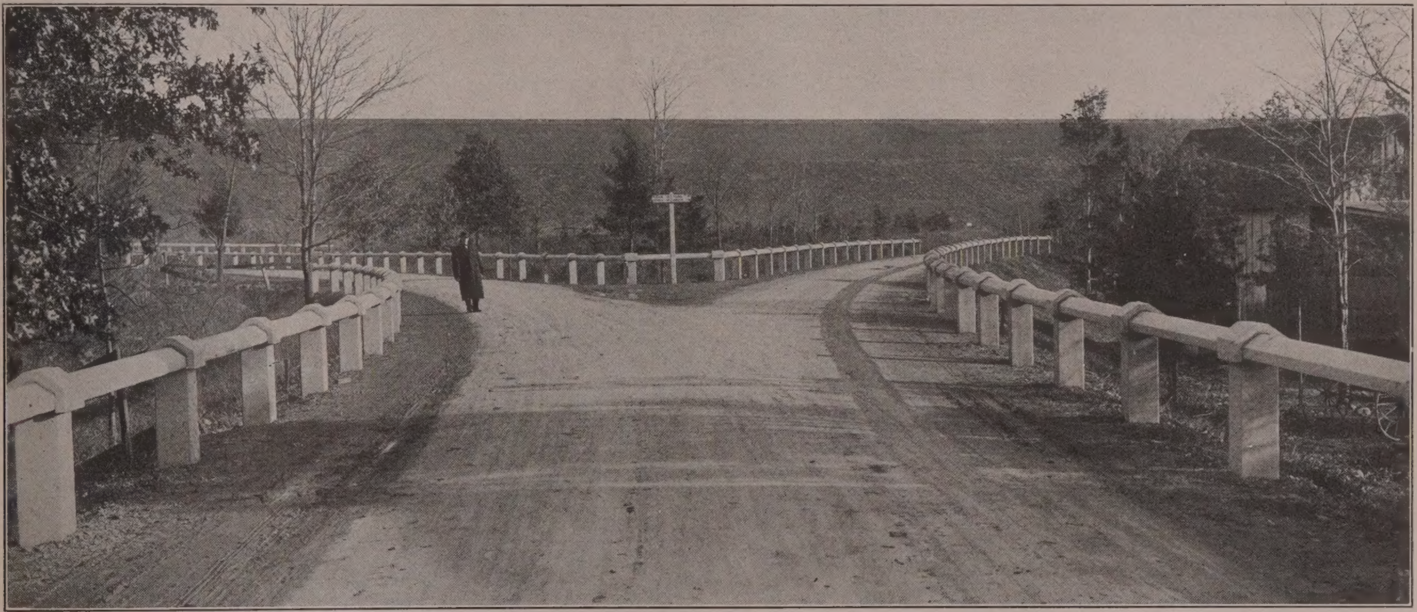
There is an exhibit room on the sixth floor containing original models made by Ericsson including steam engines, solar calorimeter, galvanometer, deep sea lead, caloric engines, rotary gun carriage, etc. Numerous other exhibits of tools, apparatus, photographs, etc., are to be seen in various parts of the building, while in the library there are many rare and valuable books and original manuscripts on exhibition.

LOCATION ADVANTAGEOUS

The Engineering Societies' Building is advantageously located midway between the Grand Central and Pennsylvania Railroad Terminals and is accessible from the principal transportation lines of the city. The building and land represent an expenditure of $1,717,000.

Concrete Guard Rails for New Roads in Catskill Watershed

SIXTY-FOUR miles of highways were discontinued and forty miles of new roads built to provide traffic routes in the vicinity of the new Ashokan reservoir of the Catskill aqueduct for New York City's additional water supply. In certain places where guard rails were needed it was decided to improve upon the familiar type of wooden fencing by substituting a construction of separately molded concrete posts and slabs. The accompanying photograph indicates the appearance of the guard rails adopted. Highway engineers may find it useful as a suggestion for treating similar structures required on their own work.



SEPARATELY MOLDED CONCRETE MEMBERS USED TO FORM GUARD RAILS ALONG RELOCATED CATSKILL ROADS

Gives Cost Analysis of Double-Course Pavement

A. F. Comstock at Meeting of Illinois Society of Engineers and Surveyors Details Construction Methods and Inspection

IN BUILDING 2½ miles of two-course pavement in Tonawanda, N. Y., extreme care was taken with every part of the construction and inspection. A. F. Comstock, associate in railway engineering, University of Illinois, outlined in detail the methods and the cost analysis in a paper presented Jan. 27, to the Illinois Society of Engineers and Surveyors. Some of these data are given below.

The method of measuring ingredients was not specified, although the bag of cement was specified to be taken as 1 cu. ft. Accordingly the following method was adopted: Three bags of cement were dumped in a box, the cement was shaken down and a mark was made around its upper limit. The cement was then removed and a number of tests were run with different men to determine the number of shovelfuls of sand and stone required to make 3 cu. ft. The men were instructed and observed to take a full shovelful each time. From these tests instructions were issued as to the number of shovelfuls of sand and stone to be placed in each wheelbarrow. These tests were repeated often enough to maintain a check on results, which were surprising in accuracy. The advantage of the method was that there was no way to increase the amount of aggregate without increasing the number of shovelfuls, and the inspector could stand some distance away, even as far as a block, perhaps, without being misled.

COST ANALYSIS—NOT DATA

The following detailed cost analysis is for a 1:1½:3 concrete slab 6 in. thick with a No. 29 American Steel & Wire wire reinforcement placed 2 in. from the top of the pavement. Transverse expansion joints were located at 33-ft. intervals, and a longitudinal joint was placed along the middle of the 48-ft. street between the 8-ft. parkings. A ⅜-in. felt strip was placed between the plates and in the joints without plates along the gutters.

TABLE 1—COST ANALYSIS 6-INCH PAVEMENT PER SQUARE YARD

Materials		
Cement, 0.32 bbl. at $1.20, f.o.b. cars	$0.384	
Sand, 0.080 cu. yd. at $1.10, delivered	0.088	
Stone, 0.14 cu. yd. at $1.21, f.o.b. cars	0.169	
Wire reinforcement at $0.76 per 100 sq. ft.	0.070	
Joint material at $0.15 per lin. ft.	0.050	
Total materials		$0.761
Labor		
Grading (12 in. of excavation on average)	$0.250	
Unloading and hauling materials 0.5 miles:		
Cement	0.032	
Stone	0.039	
Wire	0.005	
Joints	0.003	
Mixing and placing concrete	0.111	
Spreading and removing earth covering (2 in. thick)	0.008	
Sprinkling (for ten days)	0.005	
Total labor		0.453
Plant and Supplies		
Mixer rental at $10 per day	$0.020	
Fuel, oil and repairs	0.010	
Canvas, boots and other supplies and tools	0.020	
		0.050
Overhead		0.050
Total cost per square yard		$1.314

Weather conditions were, on the whole, favorable. The average rate of progress maintained while working was 720 sq. yd. per day of eight hours. Including delays by rain and repairs, the average rate for the entire period was only 500 sq. yd. per day. Deposition of 864 sq. yd. was the largest day's work.

TABLE 2—DETAILED LABOR COST

16 men shoveling and wheeling at 25 cents per hour	$32.00
2 men handling cement at 25 cents	4.00
2 men handling wire and joints at 25 cents.	4.00
4 men handling strike board at 25 cents	8.00
5 men shoveling concrete around chute at 25 cents	10.00
1 foreman at 50 cents	4.00
Engineer and fireman on mixer	6.00
2 finishers at 50 cents	8.00
Superintendent and timekeeper (½ time)	3.75
Total	$79.75

Labor cost per square yard $= 79.75 \div 720 = \$0.111$. Plowing with steam roller in well compacted road cost 1 cent per square yard for each time over. Two or three times over was the rule. Rough grading cost 18 cents per square yard, exclusive of plowing. Fine grading cost 3 cents per square yard. Rolling with 10-ton roller cost 0.3 cent per square yard.

The work described was constructed under the direction of Mr. Comstock, acting for the firm of Ellsworth Brothers of Buffalo.

State Regulation of Interstate Utilities Viewed from a New Angle

Alfred P. Thom of Southern Railway Tells Pan-American Scientific Congress Local Control Encroaches on Rights of Other States

THAT the other states, as well as the utilities themselves, suffer by the local—that is, state—regulation of interstate public utilities, such as railroads, was the burden of the argument in a paper on the relation of central to local control, presented by Alfred P. Thom, general counsel of the Southern Railway, at the second Pan-American Scientific Congress. He held that the appropriation of special prerogatives and the imposing of special restrictions by one state necessarily threw an added burden on other states, even if they did not actually block needed development. To him also there was a great lesson in the European war. He pointed out that the nation at once the most militant and the most efficient in Europe was looking for other lands to colonize, and might seek certain parts of the American continent. While that would not necessarily force us to become a military nation, he held that it compels us now to put our industrial life on the most efficient basis—and to him this is impossible under local control of utilities.

In the first part of his address Mr. Thom went back into history and developed his contention that one of the very purposes of the Constitution of the United States was to protect the weaker states against the stronger in the control of trade. And if protection was needed then, Mr. Thom thinks it is needed far more now that great transportation systems spread over the entire land. On this point his remarks were in part as follows:

TRANSPORTATION CAPACITY LIMITS TRADE

The transportation capacity of the carriers marks the maximum limit of the trade, and hence of the producing capacity, of the people whom they serve. No more will be—no more can be—produced than can be carried to market. Therefore each state, being dependent for its prosperity upon the producing capacity of its people, is deeply concerned that the transportation capacity of the carriers which serve it shall be adequate and shall not be crippled or impaired.

A broad and wise policy in dealing with the instrumentalities of commerce is a matter of supreme interest to all localities and all states. A narrow, or niggardly, or selfish policy, if adopted by any one of the states through which a railroad passes, may seriously cripple and depress the commerce of every other state which the railroad serves.

No adequate conception of the railroad problem, as it affects the development of this country and the growth of its commerce, can ignore the necessity that transportation facilities must be all the time growing and improving to keep pace with the growth and expansion of commerce—otherwise there will be no growth and expansion of commerce.

Such an increase in railroad facilities involves the constant input of new capital, for no railroad is ever finished except in a dead country. It is a mere platitude to say that new capital can be attracted only by credit. While no one state through which a railroad passes can alone establish its credit, a single state can impair or destroy it.

ONE STATE MAY BLOCK DEVELOPMENT IN TEN OTHER STATES

If a railroad runs through and serves eleven states, ten of them may be guided by broad, liberal views, and controlled by the policy of encouraging the establishment and maintenance of adequate transportation facilities. The eleventh may, however, have no adequate commercial outlook, or may be temporarily under the domination of small and time-serving politicians. It may reduce rates on state traffic so as to barely escape the line of confiscation, and thus escape the condemnation of the Constitution. It may be unwilling that its state traffic shall contribute anything to the liberal program, favored by the other ten, which would build for the future and insure the present and continuing adequacy of the transportation facilities on which all are equally dependent.

In such a case, what shall be done? Shall the ten states bow to the will or caprice of the one and allow it to control? Shall they permit the narrow views of the one state to limit the standard or the character or the quality of facilities which their people shall enjoy?

If, on the other hand, the standard of facilities is not brought down to this low level and is to be made adequate to the needs of all, then the commerce of the other ten states, or interstate commerce, or foreign commerce, or all three, must bear the burden, which the dissenting state has refused to share, of building up adequate transportation facilities.

In either case, the dissenting state, in a very effective way, regulates the commerce and the business opportunities of all.

State rates have on occasion been greatly reduced for the avowed purpose of preserving state markets for state trade, and thus excluding and discriminating against the trade of other states. It is a right of each of these states, thus oppressed by the narrow and selfish policy of one, to have its commerce freed from these state restrictions and regulated by Congress, representing all the states, in accordance with the compact of the Constitution.

ISSUANCE OF SECURITIES

As exerting an important influence on the financial capacity of the carriers, it is appropriate to consider their capacity to issue and to dispose of their securities. It is manifest that, if such issue is to be regulated by the individual states, every state is at the mercy of the others. A bond, to be available in the market, must, as a rule—especially now, when most bonds are necessarily junior liens—be secured upon the whole railroad line; and this crosses many states. One of the states, therefore, if it possesses the power to regulate the issue of securities of an interstate carrier, may disappoint and defeat a financial plan approved by all the other states and necessary to the carrier's transportation efficiency.

Even if the state does not press its authority to the extent of absolutely declining to sanction the issue, it may selfishly, and as a political expedient—and in actual experience sometimes does—attach a condition that a designated portion of the proceeds shall be spent within its borders, where it may not in fact be needed.

The power of the state to consent, or to withhold its consent, is equivalent to a power to control the character and the location of additional transportation facilities against the views and the interests of all the other states.

DELAYS MAY BE FATAL

Even if the necessity for the new capital is universally recognized, and the approval of the states is not ultimately withheld, the time necessary to permit the investigation and to secure the approval of so many would, or might, constitute a fatal obstacle in the way of a successful financial operation. Promptness—ability to avail without unreasonable delay of a favorable market—is essential to success in placing large financial offerings.

And yet nineteen states have enacted statutes, each asserting for itself the individual right to control the issue of stocks and bonds of interstate carriers. And the end is not yet, for many other states are considering legislation which will give to them a power which they see is already being exercised by others.

THE FURNISHING OF CARS

Another striking illustration of the exercise by one state of a power to discriminate against and to injure the commerce of other states and interstate and foreign commerce is found in the state laws which impose heavy penalties for failure to furnish cars or other instrumentalities for its internal commerce within a limited time.

One of the states now imposes a fine of $5 for each day of delay; an adjoining state fixes the fine at $1 per day; and the interstate commerce law fixes no per diem penalty at all. Suppose a carrier is reasonably supplied with equipment, but a large portion of it has moved in the regular channels of commerce to a point on or off its line and distant from the place where the demand for it is made. If, under these circumstances, there is a demand for a car by a shipper of interstate traffic in the state which imposes a heavy fine for delay, another is also made by a shipper in the state which imposes a light fine, and still another is made by a shipper in interstate commerce as to which no fine at all is imposed, and there is at the moment, by reason of special circumstances, only one car available to meet all three of these demands, the carrier in self-protection must deliver the one available car to the shipper in the state which imposes the largest fine, and the others must go without.

Is it not a right of the other states to have the question of a fair distribution of available car supply determined, not by one of the interested states, but by the authority which represents them all and can see that a rule of equity and fairness shall prevail?

OTHER STATUTES

In addition a long and formidable list of state statutes, already in effect, might be given, which, without the consent of the other states, impose serious burdens of expense upon their commerce, and thus upon their people. All directly discriminate, or have the effect of discriminating against their commerce, state, interstate and foreign.

Thus, three states have passed laws making it illegal for a carrier having repair shops in the state to send any of its equipment, which it is possible to repair there, out of the state for repairs in another state; fifteen states have attempted to secure preferred treatment of their state traffic, either by heavy penalties for delays or by prescribing a minimum movement of freight cars, some of them requiring a minimum movement of 50 miles per day, whereas the average movement for the United States is not over 26 miles per day —one of these states imposing a fine of $10 per hour for the forbidden delay; twenty states have hours-of-service laws, varying from ten to sixteen hours; twenty states have extra-crew laws; twenty-eight states have headlight laws, with varying requirements as to the character of the lights, and fourteen states have safety-appliance acts.

It is apparent that these and similar statutes which impose burdens and create discriminations violate the principle of just and equal treatment as against the states which have a more liberal policy, and constitute serious invasions of the field of regulation by the states which adopt them to the substantial prejudice of those which have not sought to obtain special or preferential treatment.

In order to secure equality of burden and of privilege and the benefit of an adequate and efficient transportation system, the power to regulate commerce among the states and with foreign nations was, by their own action, withdrawn from the individual states and conferred upon Congress which represents them all. In fact, it may be truly said that the Constitution itself was the offspring of the insistent demand of the states for protection in trade against the other states. It is, therefore, peculiarly a right of the states to have this purpose fully and fairly carried into effect.

THE LESSON OF THE EUROPEAN WAR

It seems not unprofitable to turn from the problem of commercial regulation, considered only as a problem of peace, to the lessons we must learn in regard to it from the great events now occurring on the continent of Europe. It will be merely fatuous in us to close our eyes to the fact that the organization of society will be revolutionized in consequence of the historic developments of the past eighteen months.

We have had it borne in upon us that the most militant and most efficient nation of Europe has outgrown its territorial limits and is looking for other lands to colonize, into which it will introduce its own national ideals, its own national efficiency and its own militant and aggressive spirit. If it should happen that her policies embrace the acquisition and colonization of certain parts of the American continent, we, in common with all the nations of the Western Hemisphere, will be confronted by greatly increased international complications, and will need both national power and national efficiency to deal with the conditions which will be certain to arise.

All this, I trust, will not involve us in the necessity of becoming a military nation, but it undoubtedly puts upon us the imperative obligation to organize our industrial life upon the most efficient basis. Not only must our resources exist, but they must be easily available. We must realize that the agitation must cease for a divided sovereignty in respect of functions which are in essence national. We must appreciate that efficient transportation is an essential condition of national efficiency, and if we are to halt or weaken our transportation systems at state lines, or subject them to local instead of central control, by permitting the imposition of burdens or the exercise of hurtful, inharmonious or unwise regulation, we will make national efficiency impossible.

FEDERAL REGULATION INEVITABLE

We must realize that inevitably commerce will eventually be regulated exclusively by our federal government. The existing system of private ownership cannot long endure if it is to be permanently subjected to the increased burdens and conflicting policies of a dual, or of a many-sided, regulation. It must be put under one master with a harmonious and constructive policy, or it will inevitably fail. When this failure comes and governmental ownership takes the place of the present system, the states will be deprived of all power, and Congress alone will necessarily regulate every detail of railroad management and all the instrumentalities of commerce.

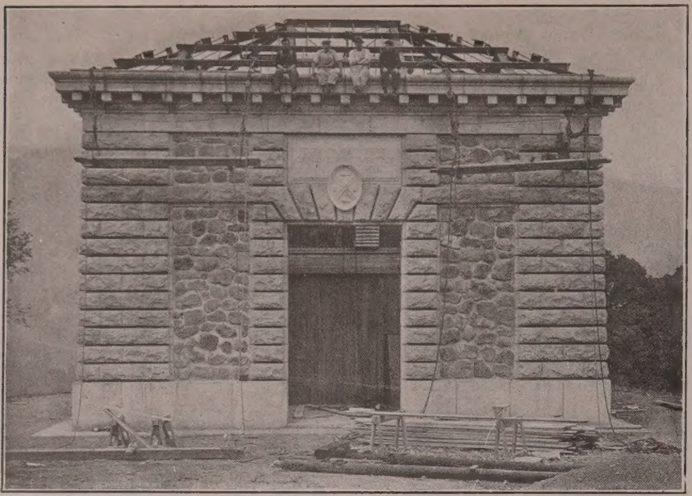
It must also be realized among us that the regulation of interstate commerce and its instrumentalities is no violation of the rights of the states, is no invasion of their prerogatives, is in no sense in derogation of their reserved sovereignty, but in reality is merely the specific performance of the contract which each state bargained for when it subscribed to the Constitution. It is their covenanted right, and the covenanted right of each of them, as well as their highest interest, that the commerce in which one in common with another state is interested shall be regulated by the fair and impartial judgment of the authority which alone springs from and is responsible to them all.

Predicts Federal Control of Stream Pollution

Prof. Earle B. Phelps Discusses Status of International Joint Commission's Work

THAT federal supervision over stream pollution will soon be in force was the prediction made by Earle B. Phelps, professor of chemistry of the U. S. Public Health Service, in a recent address before the Michigan Engineering Society. After pointing out the need for some plan of centralized stream control, instead of the piecemeal attempts at state regulation, Professor Phelps discussed the present status of the work of the International Joint Commission, which has been investigating measures for preventing the pollution of the boundary waters between the United States and Canada.

District offices were established by the commission at Detroit and at Buffalo early in 1915, he said, and a comprehensive study has been made of the general drainage and treatment problems of all sewered communities upon both sides of these rivers. These studies have not been carried to the point of complete engineering design, and the plans submitted will not obviate the necessity for further detailed engineering



EFFECTS SECURED BY THE USE OF FIELD STONE AND BRICK IN CATSKILL AQUEDUCT SIPHON CHAMBERS

studies in each local situation. They are, however, sufficiently comprehensive and detailed to justify estimates of upper cost limits with reasonable assurance, and furnish a satisfactory basis for a proper consideration of remedial policies. The results of this investigation are now being prepared for presentation.

Upon the basis of these results, together with the information the commission has already gathered, recommendations will be drawn up and submitted to the two governments. It would be premature to attempt at this time, Professor Phelps said, to forecast the exact nature of the commission's conclusions or the action that may be taken upon them by the governments. No effort has been spared to get at the facts, complex and inter-related as they are, and it is certain that whatever general policy may be recommended for the protection of the boundary waters will be the result of mature deliberation and a careful balancing of all the facts and interests involved.

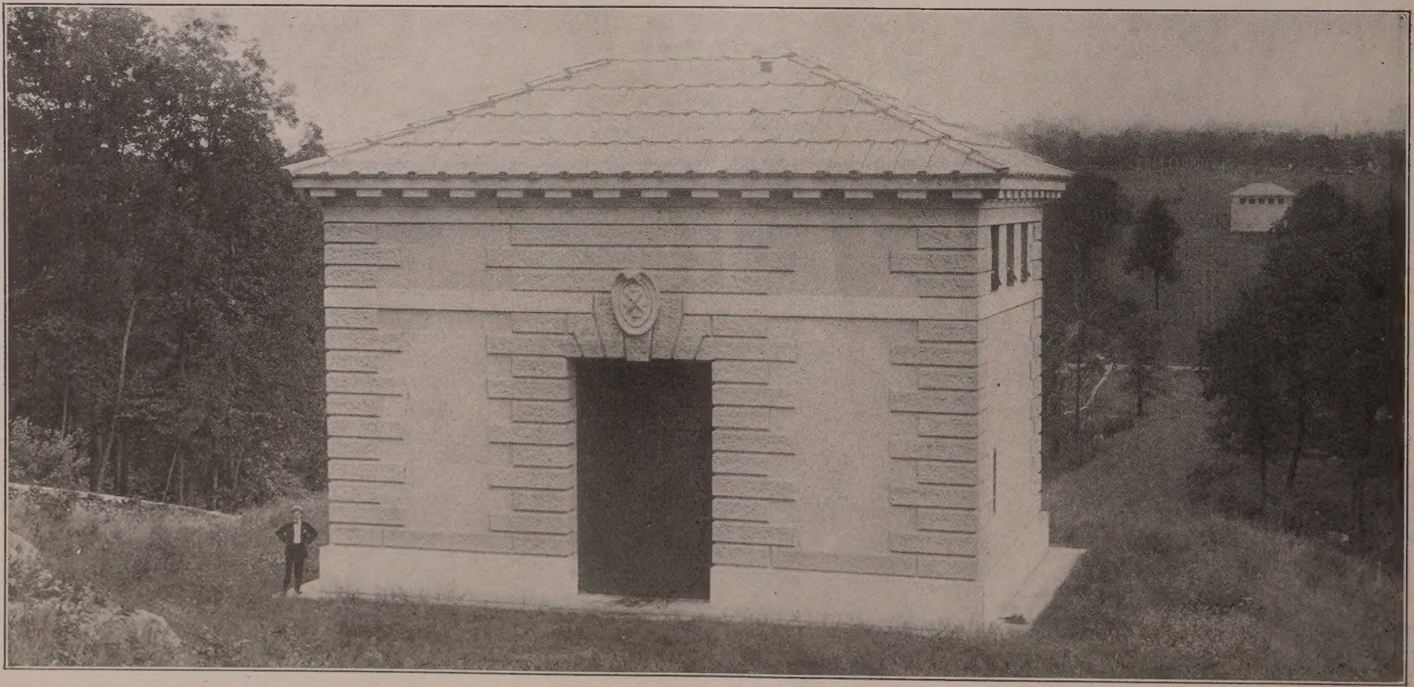
FEDERAL POLICY NEEDED

In addition to the direct interest that attaches to the final outcome of this question it is also of general interest in the matter of our interstate streams. Whatever action is taken to meet the particular case arising under our treaty obligations with a foreign neighbor ought at least to serve as a guiding principle in dealing with the more general case of our internal waters. That some form of federal supervision is going to be demanded in the near future is apparent from the present conditions. It will be fortunate, therefore, if the first step in this direction be made in connection with these boundary waters, and based upon a careful scientific study of stream conditions. It will be doubly fortunate if, out of the necessities of this situation, there shall be developed a suitable policy of federal supervision over stream pollution and the necessary administrative organization for putting it into effect. Even in the case of the boundary waters such a policy must recognize and harmonize with existing state policies in all cases where the latter are efficient. The gradual extension of these principles to the navigable and interstate streams and the development of a uniform body of state laws, supported and co-ordinated by the minimum of federal legislation and supervision, will be the logical and necessary development of the near future.

Chamber Structures on Catskill Aqueduct Artistically Treated

THE accompanying photographs indicate that the various siphon and gaging chambers on the Catskill aqueduct have been designed to present a pleasing exterior in addition to serving the purposes for which they were built. Cast concrete blocks, rough stone and brick have all been employed effectively. The views reproduced show the north chamber of the Elmsford siphon, the Wallkill gaging chamber and the south chamber of the Foundry Brook siphon. The structures were designed by the Board of Water Supply of New York City, of which J. Waldo Smith is chief engineer.

A CONCRETE AUTOMOBILE BODY, with graceful lines and devoid of seams or joints is the feature of a foreign-built 50-hp., 6-cyl. automobile that has been brought to New York City. The concrete is on a wire netting, or lath, similar to that used in concrete building construction. The dash and moldings are the only parts of the body constructed of wood.



FOR THE CHAMBERS OF THE FOUNDRY BROOK SIPHON, ARCHITECTURAL TREATMENT IN CONCRETE WAS SELECTED

Sand and Oil Road Construction Methods Improved by Massachusetts Commission

Developments in Highway Building for Light Traffic Announced in Col. William D. Sohier's Latest Annual Report—Vigilant Maintenance Necessary

SINCE it undertook its pioneer work in the construction of a road of sand mixed with bituminous material on Cape Cod, ten years ago, the Massachusetts Highway Commission has been constantly improving construction methods. Experience has proved the value of hardening the subgrade by mixing loam or clay with the sand, of applying the oil evenly to the surface, of selecting the proper asphaltic product and sand, and of machine-made mixtures. These and other features of the work, including a description of the methods employed in building roads of another type—gravel-asphalt—are discussed in the commission's report for the year ended Nov. 30, 1915. For the commission, Col. William D. Sohier, author of the report, is chairman, and Arthur W. Dean chief engineer. The report lays emphasis on the fact that the sand-oil road should be used only for light traffic, and that it is successful only when systematic maintenance is applied. Colonel Sohier comments also on the experience of Massachusetts with concrete roads, and gives figures indicating the wide range in costs of several types of construction. The total State construction last year covered 181.92 miles of roadway, divided as follows in mileage: Waterbound macadam, 23.26; gravel, 58.6; sand bound with oil and asphalt, 4.13; macadam with bituminous binder incorporated in the top course, 38.62; waterbound macadam with oil surface applied, 19.62; gravel with top surface bound with bituminous binder, 7.65; cement concrete, 5.34; gravel with oil surface applied, 16.61; Warrenite, 1.30; granite block on concrete foundation, 0.09; dirt roads, 6.7.

SAND AND ASPHALTIC OIL ROADS

The commission believes it was the first to construct a road of sand mixed with bituminous material. There are long stretches of road on Cape Cod and in southeastern Massachusetts where no stone or gravel exists. Broken stone has to be imported, often costing $2 per ton on the cars. A long and expensive haul over a sand road where a two-horse team can haul only about 1 ton per load is necessary. In many places the highway to be built was from 5 to 8 miles from the nearest railroad station.

Ten years ago the first sand and asphaltic oil road was built by the board at Eastham. At that time there were no machines available that would spread the oil evenly, even by gravity. The old sand road was graded, and about 0.75 gal. of hot asphaltic oil was spread on it and covered with all the sand the oil would absorb. Another 0.75 gal. was spread on top of this layer, and covered with sand, and on this layer 0.5 gal. of oil was spread and covered with sand. It was impossible, with the crude methods then employed, to spread the oil evenly; it ran into the ruts made by the carts and into the hoofprints of the horses that hauled the old watering cart containing the heated oil. Consequently that year and the next the surface had to be broken up, cut into as small pieces as possible with a disc harrow, harrowed and mixed with a toothed harrow, and then shaped back and rolled. After that certain places needed more oil and had to be patched. A reasonably passable road was secured in about two years at a cost of less than 25 cents a square yard for the surface, or not quite $2,250 per mile. This road is still in existence. It has required more oil from time to time, ruts have had to be filled and bunches on the sides cut off by hand or with a road machine. It has satisfactorily carried the traffic for ten years. The cost of maintenance since 1905 has averaged 2 cents per square yard per year, or about $175 per mile.

IMPROVEMENT IN CONSTRUCTION METHODS

Since this road was built the board has constructed about 25 miles of roads of sand and asphaltic oil by this layer method. The methods have been much improved. Perhaps the most important change is in the hardening of the subgrade before any oil is spread. After the road is graded the subgrade is prepared of the required width, now 18 ft., and this is hardened with clay or loam so that it is not much rutted by the wheels or pitted by hoops when the oil cart is hauled over it. The oil is immediately covered by the sand before any teams go over it and pick it up. This makes it possible to spread the oil evenly over the road surface before it is covered with sand.

There are now a number of specially equipped carts and trucks made with nozzles designed to spread the oil uniformly. The best of these spread it under pressure in several ways—by using a tight steel tank and steam from the tractor hauling the tank wagon; by steam obtained in the same way operating a pump on an oil-spreading device on the tank wagon; by a gasoline pump on the tank wagon, or by a pump driven by a sprocket and gear attached to the rear wheels of a tank wagon hauled by horses. The motor trucks have special machinery for spreading oil under pressure. The very heavy asphalts are usually spread under pressure secured by an air pump. Many of these tank wagons or trucks have burners or coil for heating and warming the oil; hence it is spread more evenly and mixed more readily. Also, a better quality of oil can be used, containing more asphalt.

LAYER METHOD

The surface of the 25.5 miles of sand and oil roads built by the layer method has cost from 21 to 33 cents per square yard, the average being 26 cents. For a road 18 ft. wide this would be $2,750 per mile, to which must be added the cost of grading, culverts, etc. On the roads in use at least five years the cost of maintenance per year has been 1 cent per square yard, or about $100 per mile per year. There are also about 25 miles of sand and oil roads on the Cape built by the towns.

In 1908 the board built its second section of sand and oil road. This was constructed by the layer method, and two years were needed to get it into reasonably good condition. Experiments were therefore made in mixing bituminous materials with hot sand. Eleven sections of road were built and a different bitumen used on each. Two qualities of tar were used and nine different oils or asphalt products. In each case the subgrade was carefully prepared of the required width and the mixture was spread as evenly as possible upon it and lightly rolled. The mixture was 4 in. thick in the middle and 3 in. thick on the sides. The sand and bituminous materials were first heated and then mixed by hand as thoroughly as possible before spreading. Eight of these experimental sections practically failed within the year. Another section was never very satisfactory, and only two remained in good condition and are still in use, having been patched from time to time. The only successful sections were those where a heavy oil with an asphalt base was used, or where this oil was used mixed with an equal quantity of "A" asphalt. This latter section was much better than the other two. These experiments clearly showed that it was possible to build a satisfactory road with sand mixed with oil asphalt if the proper asphalt product was used. From 18 to 20 gal. of bitumen was used per cubic yard of sand. The cost varied from 17 to 31 cents per square yard.

MIXING METHOD

In 1909 over a mile was built by the mixing method, using sand and asphaltic oil. This road was a success, although the oil used was rather light, and hence there was a tendency to rut. Also it was surfaced only 15 ft. in width, with the result that vehicles in passing often turned out into the soft sand shoulder and sheared off the sides of the hardened road surface. It was rapidly cut into and narrowed up, especially on curves. The second year it was all widened to 18 ft., which was increased on curves, the present standard being 21 ft. on the latter. The older roads are being widened as fast as possible.

IMPROVEMENTS IN METHODS, MACHINERY AND ASPHALTS

The commission is now using on mixed work an oil asphalt that tests 80 penetration on a Dow penetrometer. Mixing is by machinery. Until last year the sand was heated on sheets of iron with fire below, or over old boiler plates or pipes. The sand had to be constantly turned by hand, but even then frequent burning resulted, and some of the sand was not hot enough. Sand heaters in which the sand is kept in motion all the time are giving better results. It has been found advisable to spread a sealing coat of asphaltic oil of a little lighter quality over the road after rolling, covering this with sand. A sharp, strong sand well graded in the bank is used. These sands, local to Cape Cod, have been tested and found to correspond very closely with the sands used under the ordinary sheet asphalt specifications. The quality of oil asphalt used is varied according to the quantity of voids in the sand. From 18 to 21 gal. are used per cubic yard of sand. The roads are still built over a carefully prepared and hardened base, about 4 in. thick in the middle, 3 in. thick on the sides, 18 ft. wide and 21 ft. wide on curves. Better results are secured by a road scraper, keeping the mixture constantly shaped while rolling. The seal coat of lighter oil improves the surface, prevents occasional potholes and decreases the maintenance cost.

The commission has built over 23 miles of mixed sand and oil asphalt roads since 1908, and about 1.5 miles of sand mixed with tar. The cost has varied from 40 to 61 cents per square yard, averaging 52 cents. This cost would be somewhat less at the present price of asphalts.

The average yearly maintenance cost on the mixed roads that have been in use 5 years has been $0.016 per square yard; on roads in use over three years, 0.75 cents per square yard. If these roads require a seal coat every four or five years, as appears likely, the average yearly cost of maintenance will be about 2.5 cents per square yard.

ROADS WHICH HAVE FAILED

Some sections of sand and oil roads have failed, and one section of sand and tar was unsuccessful. These were built several years ago, and the failure was due to the poor quality of oil asphalt or tar used. While all the materials used were tested in the laboratory, there was little knowledge a few years ago as to what qualities were necessary either in asphaltic oils or tars. Now that Mexican and other asphaltic oils have come into use, it is easier to obtain better results. The manufacturers of both tars and asphalts have also learned what is needed and have greatly improved their processes, using greater care to secure a uniform product.

QUALITY OF SAND IMPORTANT

Roads of sand and oil asphalt construction can be used only where a sand of the right quality is available. As the commission is now building them they can be used only where the traffic is mostly light teams and automobiles, and will not stand up if traversed by many heavily loaded teams daily. The layer roads are more easily rutted by teams than the mixed roads; first, because as heavy a quality of asphaltic oil cannot be used, because it cannot be made to mix with the cold sand, and second, because by the layer method it is not possible to secure as even a mixture of the sand and oil on every part of the road. The commission and its engineers find that eight or nine motor trucks a day cause no appreciable injury on the Plymouth sand and oil asphalt road, although it is feared that a heavy motor truck traffic would not be successfully handled.

If traffic prove too heavy for such roads as above described the commission believes that they can be greatly improved and strengthened at a moderate increase in cost by using better and harder asphalts and more care in selecting and grading the sand, in heating and in mixing. By this method a standard sheet asphalt pavement can be made and laid 2 in. thick, using the old sand and asphaltic roads as a base. The same material can be used to resurface the old waterbound macadam roads where sand of the right quality is available. The traffic so far has not warranted this additional outlay.

A WORD OF CAUTION

A good road cannot be built without an oil asphalt of good quality—an oil which will bind and not lubricate. The quality of the oil and of the asphalt must be determined by standard tests, making sure that all the oil asphalt comes up to specifications. Many sands are too fine, too uniform in size, too rounded and not strong enough. Hard, strong and sharp sand, well graded in the banks, is essential. Before any contract is let or any large amount of work undertaken it is wise actually to build some experimental stretches of road, using the materials expected to be applied in practice. In warmer climates it is wise to use harder oil asphalts than in Massachusetts. When the traffic is heavy it will undoubtedly be economical to grade the sands, possibly add some stone, use a percentage of cement to make a denser mixture if the sand be not of good quality, use a portable asphalt mixer and construct a sheet asphalt road or a Topeka mixture. It is most important to build the roads so wide that they will not be rapidly destroyed by teams shearing off the sides in turning out.

CONSTANT MAINTENANCE NECESSARY

No class of road built will go to pieces faster than this type unless constantly maintained. A pothole in wet weather will soon become as large as a bushel basket, and with many holes of this kind not only is the road quickly destroyed by the traffic, but it becomes impassable. Thousands of dollars are lost yearly because of neglecting this maintenance. It means small expense. "Even when the greatest care is used in construction a few holes may develop, perhaps only three or four to the mile, the first year or two. Inspect the road, fill the holes, spend a few cents, and save hundreds of dollars," declares the report. "Maintenance begins when construction ends. Keep it up."

GRAVEL-ASPHALT MIXED SURFACES

The commission has built some gravel-asphalt road 18 ft. wide, with 3-ft. shoulders, the curves being banked and widened to 21 ft. A gravel foundation was put in wherever the bottom was bad, and about 4 in. of local crushed stone was spread and well rolled. On this was spread, as evenly as possible, about 3 in. of bituminous mixture, made of gravel that had been run through the crusher and sand or stone dust, mixed with a heavy asphaltic product. The gravel and sand and asphalt were thoroughly heated and mixed in a hot mixer, and then carted upon the road and spread. The surface was rolled down to about 2 in. in thickness, when the mixture was sufficiently cool not to crawl under the roller. Great care was necessary to insure a uniform product, and only enough asphalt to bind the mixture properly was used.

The quantity of asphalt varied according to the amount of voids in the mineral aggregate. The variation was usually from 18 to 22 gal. of hot asphalt per cubic yard of gravel. The proper mixture has about the consistency of brown sugar, and compacts under the roller, although when it is first spread and rolled it sometimes has a few hair cracks which the traffic soon rolls out. The asphaltic product in this work had a penetration of 80 to 120.

In some cases where extra heavy traffic has to be handled the commission states that it would have preferred to rebuild of granite block on a concrete base, but it was impossible to secure enough money for this from the funds available for resurfacing, without letting many other roads severely suffer.

SALEM-LAWRENCE CONCRETE ROAD

The commission has been building a cement-concrete road in North Andover on the Salem-Lawrence route, which was fully described in last year's report. Further observation of the longitudinal cracks therein described seems to indicate that they will not prove a serious defect in the use of the road if kept properly filled with some bituminous mixture. Over 3 miles of concrete road have been built, and observations of brass plugs set in the concrete on each edge of the roadway opposite the stone bounds show a maximum expansion of about 1 in. in 1000 ft. of road. The longitudinal cracks appeared due to settlements on new embankments and fills. The work was continued in 1915, about 1 mile more of cement-concrete road being built at a cost of $14,300, the width being 18 ft.

COST OF CONSTRUCTION AND MAINTENANCE

The commission is often asked for data regarding construction and maintenance cost, but such information cannot be given unless the conditions are known. Costs have been allocated on twenty different roads to show the impossibility of giving average figures. On these twenty highways, about 25 miles in length, the cost of drainage, culverts and bridges varied from $63 to $4,100 per mile. There was a small concrete bridge on the last road. On most of the roads the drainage and small culverts cost from $750 to $1,500 for each mile of road constructed. Grading and foundations varied from $1,200 to $8,700 per mile. The total cost of grading and foundation on 23.5 miles of road averaged $3,500 per mile. On the Mohawk Trail some of the excavation cost $40,000 a mile. These figures show the impossibility of giving any general data of value.

The cost of the hardened road surfaces alone may be of some value, though here again it depends on the availability of suitable local material, length of haul, cost of freight, price of labor, etc.

On four of the twenty roads a gravel surface was used. The cost of this surface varied from 15 to 27 cents per square yard, the depth being 6 to 7 in. On eleven of these roads the surface was bituminous macadam. All but one were built of local stone; some were grouted with tar and some with oil asphalt. The thickness of the broken stone varied from 3 to 6 in., less broken stone being used when there was a stone foundation. The top 2 in. on all these roads was grouted, and about 2 gal. of bituminous material was used per square yard of road. Four of these roads were 6 in. thick, and the cost, using local stone, ranged from $0.99 to $1.13 per square yard. Five were 4.5 in. thick, the cost ranging from $0.54 to $0.87 per square yard. One was 3 in. thick and cost $0.40 per square yard, and a resurfacing of an old macadam 2 in. thick cost $0.61 per square yard. One road in a country district was built of waterbound macadam 4 in. thick, on a stone foundation, and this cost $0.40 per square yard of surface. This road will be coated with light oil in the spring.

Four of these roads were built of Portland cement concrete, all averaging 7.25 in. in thickness, with a cost range of $1.10

to $1.60 per square yard. These roads were built on substantially identical specifications, and in each the cost of the concrete only is included. Such figures illustrate how misleading any general figures as to the cost of construction of maintenance of various types of roads would be. Some of the twenty-year-old water-bound macadam roads have been maintained at a cost of $100 to $150 per mile. Suddenly they have to be resurfaced and widened, at a cost of $5,000 to $10,000 a mile. This immediately jumps the average cost up to $350 to $650 per mile per year. Other sections of state highway built twenty years, where the traffic is heavy near the cities, have already been resurfaced three times, and the last time widened as well, with a bituminous macadam or other bituminous top put on. The cost of maintenance of such a road would easily be $1,000 or more per mile annually.

MAINTENANCE AND RESURFACING

With the increasing mileage of state highways, the tremendous increase in automobile traffic, and the growing use of long-distance motor-trucks, maintenance becomes of vital importance. Some state highways are now twenty-one years old, and the average age is over ten years. They are becoming worn out and are not strong enough to withstand the heavy modern traffic. Corners and curves, formerly safe for horse-drawn vehicles, are now dangerous when used daily by hundreds of motor-vehicles at high speed. Former country roads have become intercity and interstate trunk lines. The roads need widening, with improvement of curves and corners, and the surface, at least on main lines, must be reconstructed, using some permanent form of construction capable of withstanding modern traffic. This will cost probably from $8,000 to $10,000 a mile at least, but the work must be planned far ahead, done gradually, or in a few years many miles of state highway on the heavily traveled routes between the larger cities will go to pieces. The commission urges that the work be begun now, and that at least 100 miles a year should be widened and reconstructed, so that at the end of five years 500 miles of road will have been so improved. Nearly 500 miles of road have been built from ten to twenty years ago, and many miles of these roads have not as yet been resurfaced. They are thin, worn out, and beginning to be worn through by numerous heavy motor trucks.

RESURFACING AND WIDENING

In 1915 the commission had about $1,200,000 for maintenance. The first essential was to maintain as well as possible the state highways already built, over 1,026 miles in length. This was done by constant patching and by the use of bituminous covering. The drainage also had to be kept open, shoulders maintained, trees cut, and trees and shrubs obscuring the view removed. On practically all the state highways there were either section men or repair gangs in charge of the maintenance. Bituminous materials were used during the year on practically all the state highways that had not been constructed of concrete or paved, unless they had recently been resurfaced with bituminous materials. On many of these roads oil or tar has been used before, and a retreatment was necessary. Only a few years ago the authorities in charge of the roads were not in agreement as to the necessity of using some bitumen, on the top surface at least, to preserve the roads. To-day there is so much motor traffic that even in little country villages money is being appropriated to oil or tar the road surfaces. If the roads are not oiled great annoyance arises from the dust, with injury to crops. The commission is allotting all the money it can from motor-vehicle fees to help the poorer towns to oil and preserve their improved roads.

The commission easily could use twice as much money as it has available for preserving these improved highways. In 1915 about 65.2 miles of state highway were resurfaced at a cost of over $466,000, of these, 46 miles being widened at least 3 to 10 ft. The crown was reduced to 0.25 or 0.33 in. per foot, to spread the traffic over the entire roadway. About 18 miles were widened where no money was available for resurfacing. The widening cost over $130,000. While over 64 miles were widened, but 46 miles could be resurfaced. The total amount expended for widening and resurfacing was $597,200. The old standard width of 15 ft., adequate ten or twenty years ago, is insufficient to-day. The commission has, therefore, asked the 1916 Legislature to appropriate $200,000 to continue this essential work.

TRAFFIC INCREASE IN SIX YEARS

The report, when printed, will contain an appendix covering the latest traffic studies of the board. These show that in the past three years the number of runabouts passing per observation station per day has increased from 37.2 to 82; touring cars from 173.5 to 380; trucks, from 11.5 to 38, and total automobiles, from 222.2 to 500. Horse-drawn vehicles of all kinds have decreased from an average of 129.4 per station per day to 106. Observation in 1912 totaled 34,797 motor vehicles per day, with 156 total stations, and in 1915, 96,213 motor vehicles per day with 192.5 stations. The total horse-drawn vehicles in the day's test in 1912 was 20,264 and in 1915 20,328. Compared with 1909, when runabouts averaged 20.8 per station per day, the increase has been 300 per cent to 1915; touring cars in 1909 averaged 75.3 against a 405 per cent increase, and all motor vehicles showed a percentage increase per station of 420, while the horse-drawn vehicles decreased from 151 per station per day, or 30 per cent. There were practically no motor trucks on the highways in 1909, but in 1915 these constituted 6 per cent of the traffic. In the past three years day traffic at a few selected points increased 184 per cent and night traffic 68 per cent. Data are also given in the report to illustrate the increase in travel caused by good roads. On the Mohawk Trail the increase was from 30 to a maximum of 3,268 vehicles a day, and on other roads extraordinary increases are noted.

Mounted Motor-Driven Pump Tests Water Mains

Number of Tests Increased 150 Per Cent Over Old Method Using Team and Wagon to Haul Pump and Engine

TESTS of new water mains in Chicago are now made by means of a centrifugal pump driven by an automobile engine. Formerly the work was done by a triplex pump driven by a 2-hp. gasoline engine, all mounted on a wagon. As most of the pipe laying is in the outskirts of the city frequently a 25-mile drive with a team at $6 per day to cover one job was a day's work. Now it is possible to cover four or five jobs per day in different parts of the city. The number of tests has been increased 150 per cent and practically all jobs are tested.

THREE-STAGE PUMP IS DRIVEN BY THE AUTOMOBILE ENGINE

The outfit consists of a three-stage Fairbanks-Morse centrifugal pump mounted on the frame of the chassis of a ¾-ton White motor truck. The pump was specially designed for the purpose and rests in a horizontal position. It is driven by the truck through an extra sprocket and a silent chain without any reduction from the speed of the engine. A five-ply suction and discharge hose supplies 100 gal. of water per minute from hydrants at 350 ft. head.

The specifications for this equipment were prepared by the water pipe extension division, bureau of engineering, Chicago, under the direction of John Ericson, city engineer. R. S. Spaulding, engineer of the division, is responsible for the adoption of the outfit.

Engineer Reserve Outlined at Convention of National Security League

William Barclay Parsons Shows Washington Gathering Need of More Engineer Officers—How National Engineering Societies Will Supply Them

ALTHOUGH England had more than five times the number of army engineers now commissioned in this country, and far less complicated problems for them to solve than would arise if the United States were attacked, she was caught totally unprepared in this vital branch of the service by the outbreak of the European war. Plans for making available the services of every engineer in the country fit for army duty, so that this country may never be confronted with so grave a situation, have been formulated for legislation at the present Congress by the five great national engineering societies. They were outlined on Jan. 22 before the convention of the National Security League at Washington by William Barclay Parsons, chairman of a committee appointed by the American Society of Civil Engineers to co-operate with other societies and with the Government in matters of national defense. Mr. Parsons said, in part:

RESERVE CORPS OF ENGINEERS NEEDED

Last spring the five national engineering societies of the United States, realizing the great need for a very large increase in the numerical strength of the Engineer Corps of the army, should the unfortunate contingency arise, appointed separate committees to consider the problems involved. These committees, in order to avoid duplication of work, organized from their number a joint committee representing the whole profession in all its branches, whether mechanical, electrical, mining or civil, the last term covering all branches of engineering not otherwise especially described. The engineers enrolled in these societies and therefore represented by this joint committee number more than 26,000.

In the United States Army there are 210 officers in the Engineer Corps, some of whom serve with the very limited allowance of engineer troops, while the others are on special duty, usually engaged in the improvement of our rivers and harbors. These men stand in the front rank of the profession. For high character, for engineering skill and experience in their particular lines, they have no superiors; but in number they are wholly inadequate should a serious situation arise to demand their services.

OUR ENGINEERING CORPS AND ENGLAND'S

As an illustration of the deficiency in numerical strength, the Engineer Corps of the United States Army consists at present of one general officer, with rank of brigadier-general; 14 colonels, and 195 officers of rank less than that of colonel. In 1912, before the British army was affected by the war, the engineer corps of that army (known as the Royal Engineers) consisted of one field marshal, 11 general officers, 14 colonels-in-chief and 60 colonels; or 86 officers of rank of colonel and higher as compared with 15 in our army; and 1007 officers of rank less than that of colonel as compared with 195 here. These figures in the British army were exclusive of any engineer organization in the militia or territorial forces.

When the British army was called upon to take its part in a great war, although the part that the army took was but small as compared with the duties falling upon their allies, this engineer force, strong as it was compared with the American, was, like other departments of the army, wholly inadequate in strength to meet the demand that was put upon it.

But the difference between the engineer strength of the British army and of our own is even greater than what would appear by comparison of figures alone.

OUR FRONTIERS DEFENSELESS

In the British Isles the coast is amply protected by permanent fortifications or by Great Britain's mighty navy. Therefore, not only have no engineering works at home of magnitude been necessary, but not even works of minor or temporary character. The war in which the British forces are engaged has been for a large part in a country where railway and highway communications are of unsurpassed excellence and where only the comparatively lighter class of engineering works or of military field works have been required. In our own country, where our frontiers and our coast line are measured by tens of thousands of miles, there are defensive works located at the mouths of our principal harbors, and that is all. Along our great land frontiers to the north and south there is absolutely nothing. Likewise there is nothing along the actual coasts between harbors. In England, when the war broke out, nothing had to be done to protect her frontiers; with us, should war break out, there is nothing so far as land defenses are concerned to prohibit a foreign force from crossing the land frontiers, or from effecting a landing at any point on either the Atlantic or the Pacific or the Gulf coasts, except in the immediate neighborhood of the fortifications protecting our main harbor entrances.

WHAT ENGINEERS CAN DO

If a war should arise or if we were put on the defensive against invasion, engineers would be needed at once to prepare, place and maintain mines in all our harbors; to construct emplacements for large guns and light earthworks and trenches along our many miles of coast; to construct the secondary lines of earthworks to be held by such an army as could be collected at the time to protect our cities in the event of a landing being effected at any point; to locate and build branch lines of railways to reach the points selected for defense in order to transport men and supplies of all kinds, because the places on the coast most inviting for a landing are those lacking in railway communication; to build thousands of miles of highways capable of standing up against heavy motor traffic, and to repair these roads as they break down; to string telegraph and telephone lines and construct wireless stations; to make military surveys and maps; to erect barracks and supervise the sanitary drainage and water supply of camps; to furnish inspectors to supervise the manufacture of war supplies; and to do a multitude of other duties.

If the war were one of offense, as for instance to maintain the Monroe Doctrine in some South American or Central American country, by dislodging a foreign force which had already obtained a foothold, there would be needed all the above works to resist a diverting home attack, and, in addition, the doing of the same things abroad, and also the construction of harbor works in order to permit the successful landing of our own men and supplies, and the development and proper operation of local transportation lines.

WE MUST HAVE MORE MILITARY ENGINEERS

It is but necessary to enumerate some of the needs of engineer service to appreciate how inadequate in number is the existing Engineer Corps of our army. Then it must be remembered that in case of war our regular Engineer Corps would be stripped, as in 1861 and 1898, of its ablest men to make army commanders of them; so at the very time when the increase of engineers would be most demanded they would probably be actually decreased.

For many years the army has maintained a Medical Reserve Corps, in which surgeons and doctors were regularly commissioned subject to immediate call in case of war, and with their consent at any time in peace. This Medical Reserve has been found exceedingly useful in cases of emergencies, such as floods, fires and other disasters, and at present along the Mexican frontier. With this as a model, the engineer committee has urged upon the War Department the formation of an engineer reserve. Engineers and doctors may be said to be always mobilized. They are doing in times of peace exactly what they will be called upon to do in times of war, but for the sake of an efficient organization in the army, the selection of these additional men cannot be left until the arrival of a crisis. The men for such a reserve should be selected in time of peace, when there is no excitement and no pressure, when care can be taken to investigate each candidate, to select him on account of his fitness, and then each year to call upon him to do a certain amount of work—not necessarily to teach him to build bridges or railways or highways, because that he will be doing anyway, but to teach him how these same bridges and railways and highways should be best adapted for military purposes; to instruct him in the details of large gun foundations and large gun mechanism, the size and shape of field earthworks; to call upon him to study the topography of his own district, its railways and highways, so that, being informed as to plans of defense, he could at once set out to put the construction of such works in execution. This instruction would also cover the duties of a soldier, subordination, obedience and the willingness to do what he is told, and the way in which engineering methods must be changed to meet the exigencies of war, where time and not economy is paramount. This regular annual work would not turn out highly trained military engineers as the term is understood in European armies, but it would bring together a force of men highly trained in their several specialties and with some military training, and who could be ordered out at once in any emergency and without waiting for either further legislation by Congress or the approval of their commissions by the Senate, and avoid the seriously hampering disadvantages of gathering a force of men together in a great hurry without any information as to their specific knowledge, experience or personal qualifications.

PLANS FOR ENGINEER RESERVE

In the legislation which has been tentatively drafted there is a provision for an officers' reserve, into which reserve the present Medical Reserve would be incorporated. This officers' reserve, as outlined, is so broad as to include all arms and staff corps. It is proposed that men should be commissioned for periods of five years, the commission renewable with the permission of the Secretary of War. The advantage of this renewal provision is that it would prevent the officers' reserve becoming loaded with men who, while capable at the time of their first appointment for rendering service, might in the course of time become incapable from any one of many reasons. If this renewal provision is effectively exercised it will free the corps of an accumulation of human deadwood. There would be no pay attached to the office, except at such times as the men are called upon for service. They would hold rank in the army and be subject to call for service in times of war exactly the same as any other officer of the army, and in times of peace in case of emergency, with their consent.

Confining my attention to the engineers in this reserve, the men could be selected as the President or Secretary of War would dictate. They would receive the amount of annual training as outlined above. They could be classified geographically and professionally, that is to say, in what particular line their experience lay, so that the War Department would know where to call for men especially versed in railway or highway construction, bridge building, sanitation, or any other line, so that when engineers were needed the department could at once have at hand not only men but the right kind of men, and men especially trained.

ARMY MEN FAVOR PLAN

It is highly gratifying and distinctly encouraging that this plan of an engineer reserve has, so far as our committee knows, met with the approval of the officers in the army from the Secretary of War down. The following extract from a letter from an officer of high standing and rank in the Corps of Engineers is but one illustration of such official support:

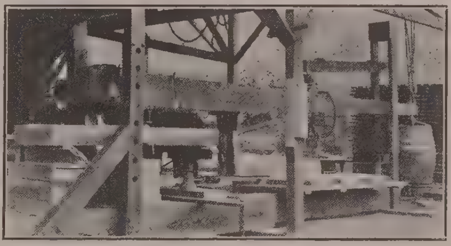
"I am strongly impressed with the importance of it, and it is good to know that men who likewise realize this importance are giving of their time and efforts to assist in putting our United States in a condition to meet any emergency which may arise. To those of us who know, it is very plain that one of our greatest lacks under present conditions will be a body of trained officers. The present war emphasizes the fact that such a body of men is a valuable asset and the lack of it a cause of disaster. I was told recently by one of the observers with the Austrian army that this was most noticeable there. He attributed the poor showing of the Austrians in the early stages of the war to the lack of proper training on the part of their officers and their subsequent successes in Galicia to the coming to their aid of the more highly trained Germans. England, too, has suffered severely, due to this same lack of trained officers and the consequent inability to fit her men for their services in the field."

The project for an engineer reserve, if enacted into law, will be the forging of one link in the chain of national preparedness and will be one step on the path marked out by that great patriot who preferred to die loving his country and beloved by his people for generations—a simple, American gentleman at Mount Vernon, and who left us, among other priceless heritages, those words: "If we desire to avoid insult, we must be prepared to repel it, and if we desire to secure peace, it must be known that we are at all times ready for war."

Home-Made Testing Machine Uses Water Barrel Weight

Wide Beams and Sewer Tile Tested by Simple Contrivance of Timber Frame and Lever, Costing Only $99

A COMPARATIVELY simple and inexpensive, but quite sensitive, testing apparatus was devised by F. W. Allen, deputy county engineer of King County, Seattle, Wash., for the purpose of breaking flat slabs wider than can be inserted in the usual laboratory testing machine. It was desired to break a brick and concrete slab 22 in. wide and about 6 ft. long, requiring a maximum load of about 10,000 lb.



TESTING SLAB BY HOME-MADE MACHINE

A timber-frame machine working on a simple lever principle, using water in a barrel for the applied weight, was constructed at a total cost of only $99. Its capacity is 40,000 lb., and it is sensitive to the nearest 5 lb., which is certainly remarkable for a machine of this character. The general nature of the construction is shown by the accompanying photograph. The weight of the water barrel is counterbalanced by a 10 ft. lever and adjustable weights as shown. The position of the bearing and hence the capacity and sensitiveness can be varied by using different holes in the bearing pin guide. The height is adjustable in the standards, as seen in the photograph. The main lever is 21 ft. long, tapered from 8 x 12 in. to 4 x 5 in. The main uprights are 4 x 6 in. timber, 7 ft. 6 in. long, braced by a 4 x 6 in. and bolted to the base consisting of three 8 x 12 in. timbers—two outside 13 ft. long and one inside 23 ft. 4 in. long. A 2-in. bearing pin and 2-in. main pin of steel with steel bearing plates, bearing pin guide, upright pin plates and stirrup for the beam are used.

Transportation of the slabs to the University of Washington was first contemplated, but this machine has proved to be exceptionally satisfactory and economical, taking widths of test specimens up to 24 in. with accurate results, and paying for its cost in a few tests through the saving in transportation costs.

Technical Students Should Receive Military Instruction

Intensive Training Under Regular Officers to Be Substituted for a Single Semester of Undergraduate Work

By WHARTON CLAY
Sales Engineer, United States Gypsum Company, Chicago

MODERN warfare has resolved itself into an engineering task. The problems of defense are engineering problems, and the civilian of engineering training will be the most useful recruit in the great volunteer army that the country must raise in case of national danger. No matter how brave or self-sacrificing the troops may be, or how brilliant the leaders, the machinery of war must be kept in smooth, running order at all times by the engineer. The engineer is needed in the scheme of national defense, but to place him face to face with problems of warfare without previous familiarity with the subject, obtained in times of peace when mistakes only add to experience instead of being contributions toward defeat, would result in disaster. If the engineering student is given a short intensive military training, so that he appreciates military needs, and during his professional career can think of engineering problems in terms of battalions, positions for mortars and sanitation for army corps, he will be invaluable to his country and may quickly rise to a position of prominence in a national emergency.

The following plan offers a simple and practical method of giving the technical college student an insight into these matters without any great expense to the government, and with no sacrifice of time or money to the student. All the machinery is now available and there are thousands of students who are in a position to take advantage of the opportunity.

TRADE SEMESTER OF COLLEGE WORK FOR REAL ARMY LIFE

The students at the various colleges who so elect should have the privilege during their sophomore or junior year of absenting themselves from the colleges at the beginning of a semester and joining a student regiment at one of our ample and unused army posts. This regiment would be officered by regular army officers of the same type as those now teaching at West Point, and a six months' intensive training extending over one vacation period would be undertaken, including military engineering, strategy, sanitation and communication, all under strict discipline and including an extended maneuver under full equipment. The course would be arranged with the co-operation and advice of the colleges, and cadets could specialize in the departments of army affairs already chosen for their civilian pursuits. Thus mechanical engineers would be sent for part of the time to a government arsenal shop, electrical engineers to a navy yard or battleship or coast defense, and railroad engineers would study transportation in the interests of mobilization and handling supplies. The cadet would return to college with a more serious outlook and this practical experience would help him in an understanding of the application of theory taught.

The various colleges would give the students one semester credit toward graduation when the course was completed, and would select such subjects to be omitted from requirements as would give the student in three and one-half years at college and one-half year in this student regiment a course fitting him as well, if not better, to practice his profession, than if he had spent the entire four years at college. It is without doubt possible for every engineer to select subjects out of his college course which have proved of little value and could very easily have been omitted.

EASY FOR THE GOVERNMENT

The government under this plan would merely maintain the student during his six months' training and give him regular army pay, relieving the student of the usual college expense during this term. Thus the process of securing such profitable material would entail no greater expense to the government than would the instruction of an equal number of ordinary recruits.

Much of real military value could be accomplished in this six months, for all the time of the training period would be devoted to military studies and drill, and the aptness of the pupil would be much above the average. It must be remembered in comparing this with West Point training that the regular collegiate mathematics, science and language, included in the four years at West Point, would be taken by these students in their college course.

OFFICERS URGENTLY NEEDED

It would not be expected that the graduates of this course would qualify as high officers, but when it is considered that England can transport her entire army to our shores in 14 days with her own tonnage, that Germany can transport 387,000 men in 16 days and 440,000 more in 31 days, Japan 96,000 in 23 days and 143,000 more in 41 days, and that each of these countries can continue with other trips, the required size of our army can be imagined, even by the layman. One million men would require 50,000 trained officers, and engineers with their special equipment should be in a position to serve their country as such. The training this course provides would be of vast importance to them and to the nation. It is practical because it is economical to the government and entails no sacrifice of time or money to the student.

The large percentage of engineers who attended the business and professional training camp at Plattsburg, and especially at Fort Sheridan this summer, proved that as a body they are patriotic and would volunteer in large numbers. Let us give them an opportunity to serve efficiently.

Looking at the product of such a course from a purely commercial viewpoint, would not such a student, with six months of strict discipline, be a more valuable employee than the usual college graduate? Would not his method of thought be more orderly? Would he not be more adaptable to circumstances of employment, with the habit of taking and properly executing orders thoroughly instilled? In short, outside of all considerations of national defense, would not such a graduate with six months of his college course under regular army officers and discipline be of more value to the engineering profession than the present college graduate?

HIGHWAY SIGN POSTS are to be erected in 1916 on California roads by the California Automobile Association under a comprehensive plan which involves a total expenditure in this work of $20,000.

Greenheart, Used in Panama Canal, Is a Timber with Exceptional Qualities

Part 2—Unusual Properties and Great Strength of This Timber Shown by Actual Tests—Durability Records Reported

By A. K. ARMSTRONG
Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.

THE UNUSUAL properties of greenheart are manifested particularly in its structure, its great weight, its superlative strength and stiffness, its hardness and its great durability. In structure, the unmagnified cross-section has been described as resembling that of cane and palm, the pores appearing very distinct. According to Baterden, the growth rings, which are often regular near the heart, spread out on one or both sides, and, running into one another, become indistinct.

COLOR AND WEIGHT

The prevalent hue of the wood varies from a pale greenish-yellow to a deep brownish-purple. The freshly cut sapwood is pale yellow, turning upon exposure to dark-greenish or chestnut. From the sapwood to the heart the color gradually deepens, and, grading more or less into the latter, makes the distinction of sapwood from heartwood difficult to all but the trained eye. This is a matter of great importance, since the sapwood is often in excessive proportion. In trees 12 in. or less in diameter, 6 ft. from the ground, only a very small amount of heartwood is developed; in 18-in. trees the sapwood is 4 in. wide; in 24-in. trees, from 3 to 3½ in. wide; and in 30-in. trees from 2 to 3 in. wide.

The wood and bark contain at least four alkaloids, among which are bebeerine ($C_{18\,or\,19}H_{21}O_3N$) and nectandrine ($C_{20}H_{23}O_4N$). The acid content of a sample of greenheart submitted to the Forest Products Laboratory based on the air-dry weight of the wood, and calculated as acetic acid, was 0.048 per cent. Teak, which is considered as corroding steel but little, contains 0.078 per cent of acid calculated in the same manner.

The specific gravity of the timber is given, by various authorities, as varying between 1.08 and 1.23, equivalent to from 67.5 to 75 lb. per cubic foot. A log tested at the Forest Products Laboratory had a specific gravity when green of 1.16, equivalent to 72.5 lb. per cubic foot. The air-dry weight (at 12 per cent moisture) was 62 lb. per cubic foot, and the oven-dry weight was 57.5 lb. On the whole it is heavier than osage orange, the heaviest of the 130 species of American woods tested at this laboratory.

SHRINKAGE AND STRENGTH

The claim has been made that greenheart has little or no moisture in its fibers, and far excels any other wood in its resistance to the absorption of moisture. Whatever may be the truth of the latter assertion, the green material tested at this laboratory contained at least 45 per cent moisture and shrank 13 per cent in volume from the green to the oven-dry condition, or about seven-eighths as much as white oak. This would lead to the belief that the above assertions are based on erroneous information. It is possible that the rate of shrinking and swelling is so low that the timber does not follow rapidly the changes in the moisture conditions surrounding it. This is true of oak.

Apparently an impression has been created abroad that the moisture content of the wood has no effect upon its strength. A small number of tests made at the Forest Products Laboratory upon small, clear specimens taken from one log of greenheart gave the average values shown in the table herewith. They show that in small, clear pieces drying does increase the strength.

VARIATION IN STRENGTH OF GREENHEART WITH PERCENTAGE OF MOISTURE

Seasoning	Moisture, per cent	Mod. of rupture, lb. per sq. in.	Max. crushing strength in component parallel to grain, lb. per sq. in.	Fiber stress at elastic limit in component perpendicular to grain, lb. per sq. in.	Shearing strength parallel to grain, lb. per sq. in.	Modulus of elasticity, lb. per sq. in.
Green	45.0	18,240	9,910	1,633	1,922	2,792,000
Air dry	9.5	26,420	13,570	2,638	1,864	3,446,000
Oven dry	2.8	22,380	16,430	2,249	1,962	3,367,000

These results indicate that greenheart, as a beam or post, is 25 per cent stronger and 50 per cent stiffer than black locust, the strongest and stiffest of the 130 species of North American woods so far tested. In resistance to shock it falls considerably below the hickories, and classes with beech, birch, ash and oak. It is a tough wood, however. The increase in its mechanical properties from the green to the dry condition will probably not take place in large-sized pieces, owing to defects, like knots, which develop in all species of timber during seasoning.

HARDNESS AND INFLAMMABILITY

Greenheart falls among the hickories in hardness. It is about as hard as dogwood and black locust. It is harder to work than oak, planing well, turning hard and badly, polishing indifferently and taking nails badly. In Demerara green timber is always preferred, owing to the extreme difficulty of working the material after it has seasoned.

Greenheart is neither more nor less inflammable than any other timber of the same dry weight per cubic foot. But since it is very heavy, it is remarkably fire-resistant. Its local name of torchwood, which seems to have arisen through special use, is, therefore, misleading.

DURABILITY

The durability of the heartwood is great. This is well proved not only by the actual experience of those who have used it, but also by tests at the Forest Products Laboratory. The results of work with twenty-three wood-destroying fungi led to the conclusion that:

"The heartwood of greenheart proved highly resistant, and, in most cases, practically immune to all of the fungi used, in spite of the fact that the organisms developed luxuriantly in the tubes. . . The sapwood proved far less resistant."

Records of durability show:

Scotland.—Piles at Glasgow and Leith are sound after from 60 to 80 yr. service, whereas longleaf pine of excellent quality is destroyed in from 15 to 40 yr.

England.—Gates of Canada Lock at Liverpool were in service 38 yr., were enlarged in 1894 and the same timber used, and still in service after 18 yr. additional use. Total service to last report is 56 yr. Some limnoria are reported at Liverpool.

Resistance to Marine Borers

The sapwood is not resistant to the marine wood-borers. This is a matter of great importance, since the detection of weathered sapwood is difficult, and the latter may be in large proportion. The shipworm and the crustacean borers (such as limnoria, chelura and sphæroma) undoubtedly attack greenheart.

In the Netherlands the attack in good-quality timber does not proceed deeper than ¾ in., and ordinarily less. This may possibly be the width of the sapwood on squared timber, since something in the heartwood, possibly one or more of the alkaloids, seems to deter or kill the shipworm. The Netherlands engineers advance the statement that the calcareous lining of the shipworm's burrow is softened by something in the wood.

Records of Resistance

The following is a summary of records of resistance of greenheart to marine wood borers:

West Indies.—Piles sheathed with yellow metal at Barbados. Average life at Trinidad is 15 yr.

British Guiana.—Flooring in slipway of dockyard was sound after 20 yr., and piles after 25 yr. Log of bullet-wood was riddled in 1 yr. Teak and oak were destroyed in 2 yr.

Netherlands.—Bearing, revetment and fender piles and lock gates at ten places on the coast give average life of 12½ yr., with no shipworm attack deeper than ¾ in. Timbers in place from 2 to 29 yr. Surinam geelhart piles were riddled in 3 yr.

Belgium and France.—Piles and other under-water timbers, safety doors on lock gates, and bollards at four places average 13½ yr. against shipworm and remain in good condition. Timbers in place from 6 to 24 yr. European beech was riddled in 1 yr.

Scotland.—Staging, test pieces, piles and sill timbers, heel and miter posts at nine places on Scotch coast average 17 yr. against limnoria. Some were eaten throughout the entire surface after 3½ yr.; some were not fit for re-use 11 yr., and many were sound after 30 yr. Longleaf pine at the same points averages about 11 yr.

England.—Piles, paddles and bracing at six points on the English coast average 20 yr. All are reported in service after from 4 to 36 yr., against shipworm, limnoria and chelura. Longleaf pine of excellent quality was destroyed after an average life of 7½ yr., and janah after about 10 yr.

Mediterranean.—One place recorded piling destroyed in 20 yr.

Suez Canal.—An experimental piece of greenheart was sound after 2 yr. An oak pile driven at the same time was badly deteriorated, and a fir pile was completely eaten away.

South Africa.—At one port wharf timber and piling showed an average life of 10 yr. against shipworm, limnoria and sphæroma. All joints in the bracing were eaten out by limnoria in 8 yr. Piles averaged 12 yr. Longleaf pine has a maximum life of 1 yr.

India.—Dock gates and piling at two places showed an average life of 14 yr. and ranged from 10 to 20 yr. Teak was destroyed in an average of 12 yr. and longleaf pine in from 4 to 5 yr.

General Uses

In Demerara the timber is used in the construction of houses, fences, wharves and board walks, and for paving blocks. It is the favorite wood for flooring, often lasting from 50 to 75 yr. without signs of wear. It is also the favorite wood with the wheelwright and shipbuilder. Large quantities of excellent charcoal are manufactured from it. In England it is used in bridge building, for carriage shafts, fishing rods, etc., and the "snaped" ends are worked up into motor-wagon spokes, belaying pins, etc.

In lock-gate construction greenheart, owing to its reliability, far outlasts iron and European oak, which are good for only about 25 yr. Moreover, it has been calculated that the amount of greenheart timber necessary for lockgates is only about three-fifths that of European oak of good quality. In England greenheart is preferred to iron, although gates of the former are heavier and harder to move.

Examples of Use in Lock Gates

The lock gates at Buenos Ayres are of greenheart, and its use in ports of the lock gates of the Panama Canal is of more recent occurrence. The wood is largely used for lock-gate construction in Scotland. It is practically the only timber used at Liverpool and Birkenhead, England, for piling and lock gates. The Manchester Ship Canal is regulated by fifty-four pairs of gates composed entirely of greenheart. The lower gates for the 80-ft. lock at Eastham are built with triple panels. Each leaf weighs 265 tons complete in air. The chief engineer reported that from 1894 to 1902 the cost of maintenance averaged about $15 per pair of gates per year; and that the only elements in their construction limiting their life were the bolts and other fastenings, which could usually be renewed without serious difficulty. The Bridgewater Canal likewise has greenheart gates.

In the Netherlands greenheart is considered to be the best timber for lock gates as well as for piling. The engineers there recommend the following working stresses for lock-gate construction: Modulus of rupture, 2900 lb. per square inch; compression along the grain, 3200 lb. per square inch; horizontal shear, 255 lb. per square inch. Based upon the values for green material (which should always be used in the calculation of stresses in structural timber) given above under mechanical properties, the factors of safety are about 6, 3 and 7½ respectively. This is good practice, provided the material is of excellent quality.

The chief difficulty in its use for lock-gate construction is said to lie in its hardness, which tends to prevent the making of a watertight joint.

Greenheart has many properties which recommend it to the European pile user. It comes in good lengths and is of nearly the same square cross-section throughout its length. One objection to it is that it splits more easily in driving than European oak, but it can be rendered safe by tightly hooping the end under the hammer. In most cases the iron ring is allowed to remain after driving, owing to the tendency of the timber to check at the ends. However, instances have been recorded where piles not ringed showed almost perfect heads at the end of 12 yr.

Some doubt has been cast upon the advisability of allowing piles to season before driving. It has been noted in Scotland that air-seasoned and weathered timber proved much less resistant to the marine wood-borers than that used immediately upon receipt from Guiana. The former timber, however, may have contained a high proportion of sapwood.

Most Satisfactory Pile Timber

From the evidence at hand it is apparent that greenheart is the most satisfactory pile timber used in the borer-infested waters of Northern Europe. In warmer climates its value is more doubtful, but even then it undoubtedly outlasts other species of commercial importance. It is necessary to consider that, in scanning data upon the life of piling, allowance must be made for the possible substitution of inferior species, or timber of poor quality. A shipment of sappy greenheart placed in a port would completely reverse the results that could be secured with heart timber.

Greenheart is in extensive use as piling in the British Isles, the Netherlands, France and, to a smaller degree, Germany. It is about the only piling timber in use in Demerara. It has been placed in service in the port works of La Guayra, Venezuela; Rosario, and Bahia Blanca, Argentina; and Coatzacoaloos, Mexico. It has never been tried out for piling in the United States. The U. S. Forest Service has, however, installed several small pieces in the Gulf of Mexico, from which it is hoped to get indications of its value under the trying conditions in that region.

The Dutch engineers estimate that it costs from 7 to 10 per cent more to place greenheart piles than those of European oak, and from 12 to 15 per cent more than to place softwoods.

GROSS OPERATING REVENUES FOR NOVEMBER, 1915, on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1,303 per mile, showing an increase of $277 or 27.0 per cent, as compared with November, 1914. Operating expenses were $800, an increase of $66 or 9.0 per cent. Net operating revenue, therefore, was $503—an increase of $211 or 72.0 per cent, and operating income was $450—an increase of $207 or 84.9 per cent. The comparison is between the highest and lowest Novembers in six years, but the increase of operating income in November, 1915, over the average for the five previous Novembers was 45.8 per cent. The operating ratio was 61.4 per cent, as compared with 71.5 per cent in November, 1914, and the same in November, 1913. Considering the three main districts, the respective ratios for November, 1915, and November, 1914, were as follows: Eastern District, 63.9 and 76.1; Southern, 65.4 and 74.5; Western, 57.4 and 65.8.

Study Silt Problem in Imperial Valley System

Chief Engineer of Development Company Thinks Proper Distribution of Suspended Matter Can Make It an Asset

RECOGNIZING the fact that the disposal of silt brought down by the Colorado River is one of the great problems of irrigation in the Imperial Valley, the California Development Company has for the past two years examined samples of the water taken daily from the canal at Hanlon Heading by means of a device with a trapdoor which secures samples at various depths. In describing the study of silt movement, J. C. Allison, chief engineer for the company, stated recently that although most authorities measure the proportion of dry silt to water in terms of weight, it has been found more satisfactory for Imperial Valley purposes to deal with the proportion of semi-saturated silt to water by volume. On this latter basis the bulk is about six times as great as the dry material, but it is pointed out that all calculations of the accumulations in the canals and the calculations of yardage to be dredged deals with materials in its semi-saturated form.

AMOUNT OF SILT ENORMOUS

During 1914 there has passed through the Hanlon headgates the company's figures show, 30,024,000 cu. yd. of solid matter. This quantity represents a total for the year of 40,532,580 tons, or an amount sufficient to cover 18,610 acres of land with mud 1 ft. deep. Dredgers operated by the California Development Company during 1914 removed 1,511,000 cu. yd. of silt, and adding to this the yardage removed by the water companies and the individual farmers, the total amount of silt taken from the canals of the system by heroic methods represented only 13 per cent of the total solids passing through the headgate. This leaves a difference of more than 26,000,000 cu. yd. of material either deposited upon the lands, discharged into the Salton Sea through the waste ways, or left to accumulate in the canal systems.

The cost of removing material from the main canals with the company's dredgers was about 12½ cents per cubic yard. The cost of handling the material removed by the dredgers and by the smaller water companies brought the total expense for removing silt from mains and laterals during the year to $500,000. This does not, however, include the cost to the individual water consumer for cleaning out his own ditches, nor does it consider the loss in crops due to the clogging of local canals at critical periods during the season. The two latter considerations, Mr. Allison states, would bring the total amount to be charged directly to silt each year up to $1,000,000.

Experience in the Imperial Valley canals indicates that of the solids brought down by the water, about half are carried in suspension and half are rolled along the bottom. It has been noted that where particles of a single size are involved the movement is with less freedom than in the case of particles of mixed sizes. If fine material be added to coarse, not only is the total load increased, but a greater quantity of the coarse material is transported.

DEPTH-TO-WIDTH RATIO

For each combination of width, slope and kind of material conveyed there is a "competent discharge" or a discharge of water which will properly carry the material without deposition in the channel. The capacity of the stream is less sensitive to changes in fineness of material than to changes in discharge or slope. The ratio of depth to width of the channel is a most important factor, and Mr. Allison pointed out that it was a primary aim in the Imperial Valley study to determine the practical ratio of depth to width and the capacity for each of the canals which would enable them properly to carry the maximum load without clogging. A more extended study of the silt problem, he thought, would result in the decision to change the design of various canals to the end that each would deliver its load of solids upon the farming lands. The system could even be arranged, he believed, so that the materials would be so distributed that the land would always benefit rather than suffer damage. That is, it would be feasible to regulate the canals so as to discharge sandy materials on the hard soil and clayey silts on the soft soil.

An item which would considerably improve silt conditions, Mr. Allison pointed out, was the rearrangement of the method of diversion at Hanlon heading. Under the present method the water is taken by gravity virtually from the bottom of the stream and passed through the headgate with no facilities for holding back the silt, the floor of the headgate being lower than the bottom of the river. It would not be a great undertaking to make a change here which would eliminate the heavier particles of sand and silt which now go into the canal. It would be a physical impossibility to prevent entirely the diversion of silt into the system, but a certain amount, the maximum possibility being about 25 per cent of the total, could be rejected by the adoption of a skimming device along the lines of the scheme in use at Laguna dam.

ALL RECORDS FOR SURVEYS made by the U. S. General Land Office were broken during the last fiscal year. The total area of accepted and approved surveys aggregated 14,339,349 acres, which was nearly double the amount surveyed during the preceding year and 4,589,872 acres more than 1909.

Sewage Gas Tank Utilized for Light and Heat

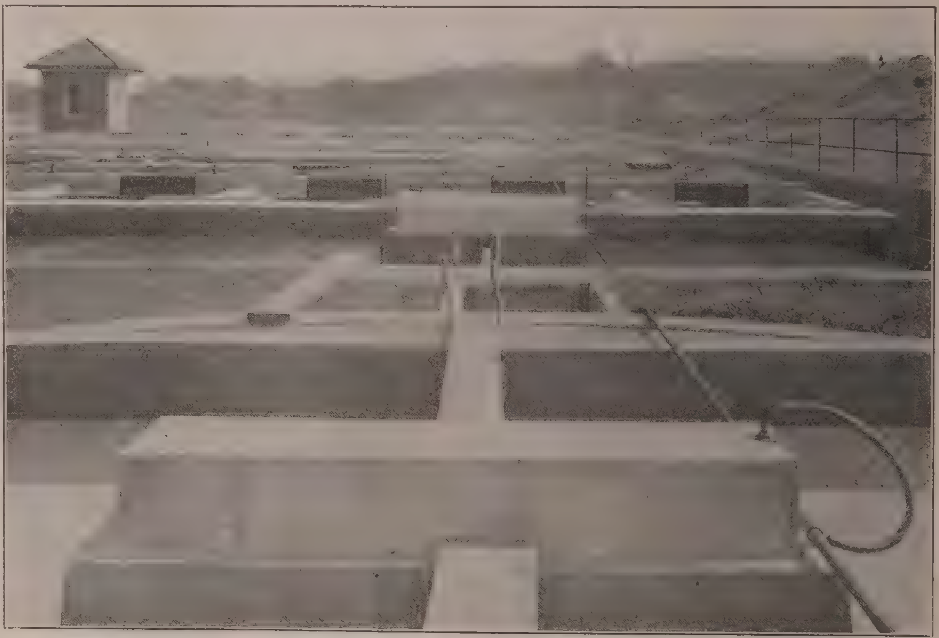
Vents on Imhoff Units Capped to Yield By-Product for the Use of the Laboratory and for Domestic Needs

By CHARLES C. HOMMON
Chemist and Bacteriologist in Charge,
Atlanta, Ga.

BY capping the vents of the Imhoff tanks at the Peachtree sewage treatment plant in Atlanta, Ga., it has been possible to collect an abundant supply of gas and utilize it for purposes of lighting and heating the laboratory and the home of the writer. The gas has a high calorific value and as a sewage plant by-product can probably be used advantageously in other ways to reduce the maintenance cost of the works.

PREVIOUS INVESTIGATIONS

Everyone familiar with the operation of sewage treatment plants knows that in the process of breaking down the organic matter by the bacteria, different kinds of gases are liberated. The composition and quantity of the gases that are liberated from treatment devices vary somewhat, due to the nature of the different sewages, types of tanks used, temperature, etc., but it has always been observed that the bubbles rising to the surface of the sewage in the tanks were inflammable. At several places in England and Germany, the gases of decomposition have been collected and measured, and in this country, George A. Johnson, in his report on the Columbus test, and Clark and Gage (1915) in their report of the Massachusetts State Board of Health, give data on gas production from septic tanks. The explosion in the covered septic tanks at Saratoga Springs, N. Y., where the roof was blown off the tanks, is evidence of the quantity and inflammability of the gas. The septic tanks at LaGrange, Ill., were provided with lamp posts and burners to consume the gases, but the scheme was never completed.



COLLECTORS OVER GAS VENTS OF IMHOFF TANKS ARE U-SHAPED METAL TROUGHS

METAL COLLECTORS DESIGNED

The problem of supplying gas for the laboratories at the sewage treatment plants at Atlanta came up for consideration when the laboratories were designed, but on account of the long distance necessary to pipe the gas from the city, the scheme was abandoned and it was decided to put in a gasoline gas plant. This was done at the Peachtree plant; it was quite successful, but expensive. As soon as the digestion in the Imhoff tanks became active, there seemed to be considerable gas escaping from the central gas vents. A metal collector was designed and built, as is shown in the accompanying photograph, with a view of collecting the gas and using it in the laboratory in place of the gasoline supply.

The collectors are U-shaped metal troughs, 6 ft. x 1 ft. 5 in. x 2 ft. 5 in., and made of No. 22 gage galvanized iron with a ¾-in. opening at one end. At first they were arranged with counterweights, so that when the quantity of gas collected in the hoods was equal to 4 in. of water, they lifted and broke the water seal, but since a gas holder has been installed all hoods are fastened in place and the excess gas escapes at the main holder.

AMOUNT OF GAS MEASURED

On measuring through a meter, it was found that the gas collected from three vents amounted to 125 cu. ft. per hour. As there are thirty vents available, and assuming that all of the vents are giving off gas at the same rate, there would be a total gas production of 1250 cu. ft. per hour, or 30,000 cu. ft. per day. Measurements of the quantity of gas were taken at two different intervals, each measurement covering one week. There is an uncertainty just what effect the temperature changes will have on the quantity of gas liberated, and whether or not all the vents are producing gas at the same rate as the three that were measured. It is a known fact that the lower the temperature, the lower the gas production, but just what the ratio is will have to be determined. However, after allowing a good substantial decrease, it would seem that there is a superabundance of gas for the laboratory.

GAS HOLDER INSTALLED

On finding there was sufficient gas produced to warrant its collection, a gas holder similar to that used to store artificial gas was built, as shown in the photograph. The holder has a capacity of 1400 cu. ft. and has a two-fold purpose. First, it holds a supply on hand, so that when the gas is cut off from the main supply, for any reason, the fires do not go out. Second, it maintains a constant pressure on the service pipes, which was not possible when the gas was used direct from the collectors.

At the present time ten gas vents are supplying sufficient gas to run all the Bunsen flames, incubators, lights, and a heating stove in the laboratory, in addition to two large heating stoves, a cooking stove, and a hot water heater in the writer's residence.

ANALYSIS, IN PERCENTAGES, OF GAS LIBERATED FROM IMHOFF TANKS AND OTHER SOURCES

	Imhoff Tanks	Natural Gas*	Water Gas*	Coal Gas*
Hydrogen	8.6	1.31	30.0	47.49
Methane	84.1	87.75	24.0	38.67
Carbon dioxide	4.6	6.60	...	1.04
Carbon monoxide ..	...	....	29.0	6.74
Nitrogen	3.1	4.34	2.5	0.85
Oxygen	0.4	....	0.2	....
Hydrogen sulphide..	...	....	1.5	....
Ethylene	...	....	12.5	5.21
Illuminants	...	....	0.3	....

*Note—These tables taken from Van Nostrand's Chemical Annual—Olsen.

The flow of sewage at present is 8,000,000 gal. per day, and the temperature is 55 deg.

As will be noted by comparing the tables, the gas from the Imhoff tanks compares very favorably with natural gas, and our experience in using it in the laboratory and heating with it demonstrates that it is a gas of high calorific value. The number of British thermal units produced from 1 cu. ft. of carbureted water gas is about 700, coal gas 600, and natural gas about 1000.

GAS HOLDER OF 1400 CU. FT. CAPACITY EQUALIZES SUPPLY AND MAINTAINS CONSTANT PRESSURE ON SERVICE PIPES

Since most sewage laboratories are located at the plant and, as a rule, are outside of the incorporated limits, which does not allow them access to the ordinary gas supply, it would seem that this sort of a gas supply would be very valuable. This has certainly been the case in Atlanta. The design of the Imhoff tanks as a rule makes the collection of the gas very simple, because of the fact that all of the gas from a large area has to escape through a small opening. The equipment for collecting the gas is simple, inexpensive, and there is practically no danger so long as ordinary precautions are observed.

ANALYSES, IN PERCENTAGES, SHOWING THE COMPOSITION OF GASES COLLECTED FROM SETTLING TANKS FROM DIFFERENT CITIES IN THE UNITED STATES AND EUROPE

Source	Methane	Nitrogen	Carbon dioxide	Oxygen	Hydrogen	Illuminants	Analyst
Atlanta	84.1	3.1	4.6	0.4	8.6	....	Chas. C. Hommon.
Chicago*	84.9	6.2	8.6	...	...	....	R. H. Jessie, Jr.
Urbana,* Ill.	81.0	6.1	12.3	0.13	...	....	R. H. Jessie, Jr.
Columbus*	83.5	9.3	8.1	...	...	....	R. H. Jessie, Jr.
Worcester*	57.7	32.5	8.2	1.2	...	....	Kinnicutt and Eddy.
Lawrence,* Mass....	78.9	16.3	3.4	0.5	...	....	Gill.
Manchester,* England	73.0	16.0	6.0	...	5.0	....	Fowler.

*Report—R. H. Jessie, Jr., "The Composition of Insoluble Gases Formed by Decomposition of Organic Matter."

It is possible that this by-product can be used to a good advantage in a great many other ways around a sewage plant. It might be used to make steam, that in turn could be used to dry out the sludge more readily. This could be done by running a system of steam pipes through the sludge bed, and in this way dispose of it on a minimum area. The gas could also be used to run a gas engine, which in turn could be used to drive an electric generator, water pumps, etc.

The only odor that has been perceptible around the Peachtree plant was the odor of this escaping gas, and it is the writer's plan to put collectors over each gas vent next spring and burn the gas in order to get rid of the odor, even though we do not utilize the heat energy produced.

Pennsylvania Begins Large Coal Pier at Baltimore

Small Pier Cars on an Endless Cable, Together with Traveling Unloaders, Will Take Place of Ordinary Systems

WORK has been started by the Pennsylvania Railroad on the construction at Canton wharves, Baltimore, of a new coal pier of large capacity which is expected to prove one of the most efficient in the world. It is thought that the structure will be completed by early summer. It will provide facilities for loading 20,000 tons of coal per day into vessels.

The pier will be 940 ft. long and 66 ft. wide. It is to be built on creosoted piles with reinforced-concrete floor and concrete bulkhead. Space will be provided for loading four vessels at a time, utilizing both sides of the structure.

In order that the work of transferring coal from the cars to the ships may not be hampered in cold weather, a "thawing house," with a capacity of thirty cars, is to be provided. Coal frozen in the cars will be quickly thawed out by steam so that it can be easily dumped.

OPERATION

The pier will be operated as follows:

The cars will be pushed from the yard up on a "kick-back," whence they will descend by gravity to a dumper, where they will be picked up and turned over, emptying the coal into a hopper. Under this hopper small 4-ton cars will be run, by means of an endless cable, up an incline and out on a trestle along the center of the pier. On both sides of this trestle traveling unloaders are to be provided, which can be moved to any location desired. The small cars will be dumped automatically into hoppers constructed on these unloaders. The coal will then be elevated by a conveyor to telescopic chutes lowered into the holds of the vessels.

There will also be constructed storage bins at the end of the pier for different grades of coal for local harbor trade. These boats will be loaded by means of a small traveler.

The plans for the pier include the construction of a storage yard, for loaded and empty cars, having a capacity of 1000 cars.

The Maryland Dredging & Contracting Company, of Baltimore, has been awarded the contract for dredging at the dock and grading the new yard. The pier will be built by the Arthur McMullen Company, of New York, and the machinery will be furnished by the Mead-Morrison Manufacturing Company, of Chicago.

Throttling Gates Save 300,000 Gal. of Water Daily

Caleb M. Saville Describes Method Employed at Hartford to Conserve the Supply During a Period of Scant Supply

By throttling the gates on the three supply mains leading to the city so that the pressure during the period of least draft was but a few pounds higher than that at maximum draft, 300,000 gal. of water per day were saved at Hartford, Conn., according to a paper read before the New England Waterworks Association at Boston, Dec. 8, 1915, by Caleb Mills Saville, chief engineer, Board of Water Commissioners of Hartford. To provide for sudden drafts for fire protection service, experienced and reliable men were stationed at nearby points, during the period of throttling, to open the gates quickly if the necessity should arise. The pressure on sprinkler systems was from 4 to 6 lb. greater during the period than at the period of maximum draft.

RATES OF DRAFT

The water supply of the city is brought to the distribution system through three supply mains, one 30-in. line entering the southwest part through Park Street, and two 20-in. lines entering the central part through Farmington Avenue. Ordinarily the pressure at City Hall varies from a minimum of 58 to 60 lb. from 7 to 10 a. m., to maximum of about 72 lb. between midnight and 4 a. m., the respective rates of draft at these periods being 14,650,000 and 4,800,000 gal. per day.

Two years ago, during a scarcity of water, the method of reducing the pressure in Hartford by throttling and, by this means, conserving the supply, was tried. The test resulted in a saving of about 300,000 gal. per day, estimated from the Venturi meter record at the effluent gatehouse.

Because of the importance of the matter, and its relation to fire protection, four reliable employees, whose regular work was the maintenance and repair of the gates, were assigned to handle the gates. Fire engine houses, conveniently located, were chosen as stations for the men, two being assigned to each house, one located 1600 ft. and the other 900 ft. from the operated gates. From 4 p. m. to 5 a. m. the endeavor was made to hold the pressure in the city a few pounds above that registered during the period of maximum draft, it being assumed that any industry having sufficient pressure during the forenoon would not be seriously inconvenienced if the same pressure were maintained at night.

PRESSURES WATCHED CONSTANTLY

By careful comparison the difference in pressure at City Hall and at one of the engine houses was ascertained. A recording pressure gage was installed at the latter. By opening and closing a 20-in. gate in Farmington Avenue the pressure at this point was kept at a slightly higher point than that shown during the period from 7 to 10 a. m. In order to accomplish this result the man stationed at the engine house constantly watched the pressure gage from the time the main gate was closed until about midnight. During the evening, on account of gradually decreasing consumption, the pressure rose, and the gate was throttled down gradually. At about midnight, on account of the practically constant draft until 6 a. m., no additional attention was usually required. All three gates were opened at about 5.15 a. m.

The four men assigned to the work from midnight to 5 a. m. slept at the engine houses under the same conditions as the firemen, with similar arrangements for quick dressing and getaway. Close check could be kept on their conduct from inspection of the autographic chart records on gages located at City Hall and at the engine houses. It was found that it took from 1 to 2 min. for the men located at the stations to get to the gates, and from 2 to 3 min. to get full pressure. During the actual throttling period (about 12 hr.) it appeared that the actual reduction in draft was at a rate of about 600,000 gal. per day. Of the quantity passed 3,750,000 gal. per day went through the valve on Park Street, and the remainder through the throttled 20-in. gates on Farmington Avenue. It thus appeared that the entire city was getting a proper proportion of the supply, and that a sudden draft in any section could be quickly met.

PRESSURE FOR SPRINKLER SYSTEMS

For fire protection it is imperative that the supply for sprinkler systems be maintained. The pressure on these during the throttling period was from 4 to 6 lb. higher than that during the forenoon hours of each day. Under conditions of piping approved by the Associated Factory Mutual Fire Insurance Companies, fifty sprinkler heads on the top of a four-story building are satisfactorily served when there is available an average discharge for each equivalent to about 12.9 gal. per minute when all are discharging at once. This condition will occur with a street pressure of about 55 lb. per square inch and a pressure of 20 lb. per square inch at the top of the riser. Under this condition a floor space 100 x 50 ft. would be covered with a total discharge of about 645 gal. per minute.

As a part of the fire protection system, all factories maintain watchmen and the noise of running water from even one or two sprinkler heads should be quickly noticed and investigated. With any adequate system of control, before any large number of sprinkler heads could start action, an alarm would be rung in and the gates fully opened to provide for a large fire draft.

EFFECT OF SUDDEN INCREASE IN DRAFT

Before entering on the work several computations were made as to the effect of a sudden increase in consumption with the gates throttled. It appeared that a sudden draft of 550 gal. per minute would cause a drop of from 4 to 5 lb. The computations were checked roughly by observation of the conditions that obtained when a locomotive filled its tank at the railroad station, and, to a finer degree of accuracy, by a test run at a pipe yard. This rate of drop would seem to indicate that if a large number of sprinkler heads let go at once the drop in pressure would not be much in excess of 5 lb. before an alarm could be turned in and the gates on the supply lines opened.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Is Crystallization of Steel Under Service Doubtful?

SIR: Your editorial on page 35 of the issue of Jan. 8 contained a statement to the effect that the theory of progressive crystallization in steel is no longer held to be sound, and that the so-called granulation of steel is due to a condition inherent in the metal when it is rolled. If this statement is intended as a general one I cannot agree with it, because I have found hundreds of cases where progressive crystallization has been manifest. On old boilers of steam locomotives it is a common occurrence to find the studs, which are screwed into the outside sheets for various purposes, so brittle that they may be knocked off by a single blow from a hand hammer. In fact, it is well understood by railroad machinists that the studs have become weakened and when the boilers come into the shop no attempts are made to unscrew them. Instead, they are knocked off and the remaining portion chipped out so that the new ones can be substituted. In all cases the breaks show a crystalline structure.

Admittedly, these conditions are special ones, as the metal in such cases is exposed to great variations in temperature and to extreme vibration. Nevertheless, the fact that progressive crystallization can take place under these circumstances prevents the general application of the theory supported in your editorial, and in view of numerous other examples, which may be less definite, but which are certainly good evidence, there seems to be logical reason for believing that under many other circumstances progressive crystallization can, and does, take place frequently.

F. KINGSLEY,
M. Am. Soc. M. E.
New York City.

Lug Angles and Stress Distribution

SIR:—In the Engineering Record of Oct. 23, 1915, page 512, the results of tests by Professor Batho on the effect of lug angles indicate that for double angle members with fixed connection plates the variation of stress throughout the cross-section is largely due to shear. As a simple, approximate method of determining the probable variation due to shear, consider Fig. 1. Upon the application of a load, assuming the center of the member to remain stationary, a moves to a', b to b' and c to c'. The stress at a will be zero, at the center section the stress S_m will be assumed to be distributed uniformly and at any point c the unit stress will be assumed to be proportional to the distance x from a toward the center section. Then at the section cd the stresses will vary as indicated in Fig. 2, and it will be assumed that the stress at all points of the riveted leg is equal to S_d.

By equating the total stress at cd to the total stress at the center section, there is found:

$$S_d = \frac{(1 - x/L) A_1 + A_2}{A_1/2 + A_2} S_m \qquad (1)$$

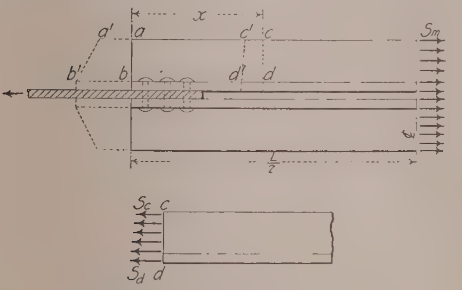
in which S_d is the maximum unit stress at section *cd*, S_m is the average unit stress at any cross-section, A_1 is the area of the outstanding leg and A_2 is the area of the riveted leg.

For equal angles, $A_1 = A_2$ and

$$S_d = \frac{4}{3}\left(1 - \frac{x}{2L}\right)S_m \qquad (2)$$

For Professor Batho's results on specimen 3, without lugs, the value of x for the end section was probably approximately 13 in., and L was a little less than 56 in., for which the value of S_d, computed by equation 2 is $1.18S_m$, and the corresponding observed value reported by Professor Batho for the average of the two angles is $S_d = 1.36S_m$. However, the stresses were not uniformly distributed at the center section, for which the average for the two angles for this case was $S_d = 1.17S_m$. The variation of 17 per cent at the center section may be attributed to flexure, or of the 1.36 for the end section, approximately 0.17 is due to flexure, and 1.36 — 0.17, or 1.19, should be the ratio of maximum to mean stress attributable to shear, which agrees very well with the value computed by equation 2.

In the case of connections with lug angles, if the shearing deformation in the lug angle is assumed to be the same as that in the outstanding leg to which it is attached, the lug may be considered to increase the effective length of both x and $L/2$ by an amount equal to its own length. For specimen 3 of Professor Batho's tests the value of S_d computed in this manner is $1.13S_m$ for angles with lug connections. For this case Professor Batho's observed values were $S_d = 1.23S_m$ for the end section, and $S_d = 1.12S_m$ for the center section. Deducting the value 0.12 from 1.23 leaves 1.11 as the ratio of maximum to average stress for the end section, attributable to shear, and this value also agrees very well with the value (1.13) which was computed by equation 2.



STRESS VARIATION DUE TO SHEAR

L. A. WATERBURY,
Professor of Civil Engineering, University of Arizona.
Tucson, Ariz.

Why Is Registration in Civil Engineering Decreasing?

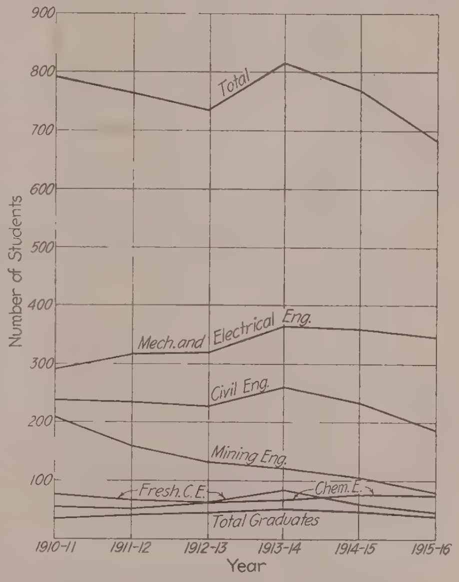
Sir: We have noted with interest in Engineering Record of Dec. 18, 1915, the editorial, page 746, and the article, page 766, upon the query, "Why Is Registration in Civil Engineering Decreasing?" and submit the accompanying classification of engineering students at the University of California. Total registration in civil engineering has been remarkably uniform from 1910 to 1914, with a slight rise in 1913. About the same statement may be made of the freshman enrollment for the same period. The decrease, therefore, is striking for 1915-16.

We consider the following possible causes as operating at California:

1. Financial depression;
2. The Exposition year;
3. The gradual development of what is termed the California six-year high school, which reduces university enrollment in the freshmen and sophomore years since such high school students are apt to find their way into business and the professions without attending the university.
4. The College of Agriculture at the University of California has been most generously endowed during the past decade. Many men who heretofore have studied engineering are enrolling in that college, not necessarily for the normal courses in agriculture, but for such specialties as agritural irrigation, forestry, farm mechanics, etc.
5. The University of California maintains a College of Commerce. Male students are enrolling there for courses which emphasize economics, statistics, accounting, etc. In earlier years students who did not desire to take the regulation letters and classical courses would instead enroll in the engineering departments.
6. Within the last five years courses in public health and home economics have been programmed. Such courses attract students who otherwise might study sanitary engineering subjects.
7. In late years our chemistry department is offering increasing opportunities for the study of chemical technology, while the growth of industrial plants in the San Francisco Bay region is producing new means for employment. In the last two years, particularly, it has been noticed that students who otherwise might have taken civil engineering have selected schedules emphasizing gas engineering, the petroleum industry, chemical and industrial problems.
8. We believe that civil engineering enrollment, at present, tends to be reduced not only by the above causes but also since the general public has the impression that there are more engineers being graduated than there are positions to be filled. Moreover, the parents and guardians, and intending matriculants have no clear ideas regarding the content of a civil engineering course. The word "civil" is not understood.
9. Again, in the San Francisco Bay region during the past ten years, there have been erected at least three technical schools and business colleges, two in Oakland and one in San Francisco, which give short courses, both day and night. Students who feel that they cannot afford the time and wish to work quickly on one subject are allured to these schools. Such local institutions are attracting larger numbers of students as the schools become better equipped and in proportion as the university increases the standard of its matriculation requirements.

We have observed your editorial comment on page 746: "Unless the curves soon change and tend upward again, faculty readjustments and idle educational plant are sure to follow." Such a conclusion can hardly be applied to the engineering departments at the University of California. It might perhaps be justified in an institution which restricts its instruction solely to engineering. Though registration in civil engineering at California has relatively decreased (particularly when we observe that the total enrollment in the whole university has vastly increased) nevertheless the civil engineering department gives more man-hours of instruction to-day than ever before and its equipment and laboratories are crowded. Why? Because though students register in architecture, agriculture, forestry, irrigation, commerce, public health and home economics, chemical technology, they yet need to elect fundamental courses offered by the civil engineering department.

We believe it may be generally stated that during the last decade many students have attended engineering courses in the various institutions of the United States, who not only have not been properly prepared for the work in high school, but in addition were not mentally fitted by talent or interest. Of any group of one hundred students in civil engineering, who have come under the writer's influence during the last twenty years, at least 20 per cent should never have attempted the study of civil engineering at all; and an additional 20 per cent will never greatly profit by their study. Such students would have done more wisely to enter trades or business immediately, or should have pursued a decidedly different curriculum of study either in another profession, like medicine, or in a general course in letters and sciences.



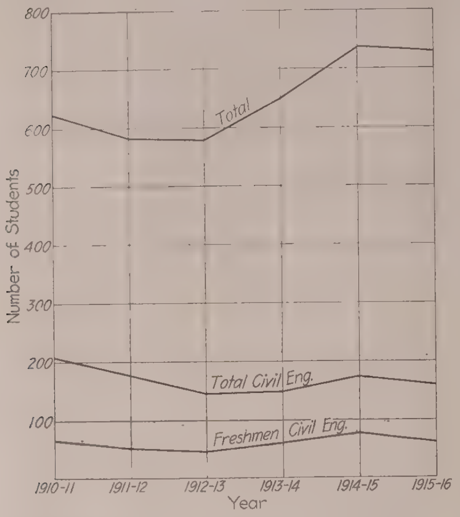
CLASSIFIED ENROLLMENT OF ENGINEERING STUDENTS AT UNIVERSITY OF CALIFORNIA

If the decrease in enrollment in civil engineering may be shown to include mainly those least adapted, there would be cause for satisfaction and congratulation, but if the decrease include a large percentage of the stronger individuals, then must the tendency be deplored, for there is always much room at the top of every profession.

C. DERLETH, JR.,
Dean, College of Civil Engineering, University of California.
Berkeley, Cal.

Sir: The accompanying diagram gives the statistics of engineering attendance at Iowa State College. I wish to offer one serious criticism on the statistics in engineering as published in your issue of Dec. 18 and discussions based on them. This criticism is that the statistics do not cover a period long enough to warrant correct conclusions. Engineering attendance curves should be extended back to 1890 to cover a complete cycle of growth. Statistics extending only from 1910 to the present are bound to be misleading.

The enormous increase in engineering attendance between the years 1896 and 1907 is one of the main causes of decrease in engineering attendance since that time. An important cause of the apparent decrease in civil engineering attendance, as compared with attendance in other engineering courses, is the constant tendency to differentiation and specialization. Civil engineering originally included mechanical egineering, electrical engineering, and in fact all other branches of engineering except military. Civil engineering now includes what is left after the separate branches have been established, and each new branch makes an apparent decrease in civil engineering, which is not due to a real decrease in the number of civil engineers.



ENROLLMENT OF ENGINEERING STUDENTS AT IOWA STATE COLLEGE SHOWS CHARACTERISTIC DECREASE IN PROPORTION OF CIVIL ENGINEERS

In recent years, for example, there has been a development of agricultural engineering which has drawn heavily from civil engineering attendance at the Iowa State College. A professional four year course in agricultural engineering is offered at this college, leading to an engineering degree, with a present enrollment of 101. This course was first offered in 1909. A four years' course in structure design is also offered at the Iowa State College, beginning in 1914, with a present enrollment of 38. There can be no doubt that the courses in agricultural engineering and structure design have drawn heavily from the attendance in civil engineering.

The sum of the enrollment in structure design, agricultural engineering and civil engineering this year will exceed 300, as compared with 285 in civil engineering alone in 1908. This view may be made clearer by comparing the statistics in civil engineering at the Iowa State College with those of the State University of Iowa, where there has been no corresponding differentiation of courses this period, and where there has been an actual increase in civil engineering attendance.

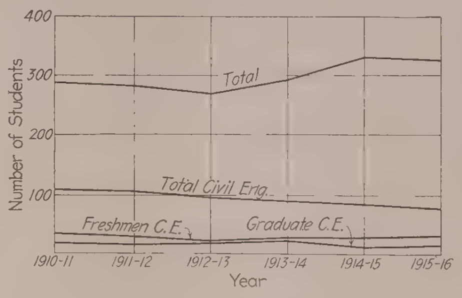
Even in the case of engineering schools where there has been no differentiation, engineering courses in recent years feel the effects of this specialization. They even feel seriously the recent and present popularity in instruction in agriculture. A very interesting phenomenon in the growth in agricultural attendance in recent years has been the large extent to which agricultural students have been attracted from the cities.

My personal forecast of the future in civil engineering attendance is for a marked increase, unless unusual conditions such as war or wide-spread business depression should interfere with the natural progress of the country. When the statistics of attendance since 1890 are considered and when differentiation of engineering courses is properly taken into account, it will be found that the general tendency is upward and that the curve of attendance is still concave upward, but the true facts cannot be brought out by such limited statistics and short time curves as were shown in the article of Dec. 18.

A. M. MARSTON,
Dean and Director, Division of Engineering, Iowa State College.
Ames, Iowa.

Sir: The accompanying diagram shows the total enrollment and the civil engineering enrollment at the University of Colorado for the years 1910 to 1915 inclusive.

It is very difficult to analyze the registration in civil engineering in the University of Colorado. A study of the registration in civil engineering before 1910-1911 shows a very rapid increase in civil engineering students just previous to the period mentioned. The largest graduating class in civil engineering we had had before 1910-1911 was ten men, with an average graduating class much below this number. The present graduating class will have forty-five men, of which fifteen will be civil engineers.



SMALL VARIATION IN ENROLLMENT AT UNIVERSITY OF COLORADO

The falling off in civil engineering registration in general is doubtless due to the slump in business conditions and, also, to the general interest in automobiles, wireless telegraphy and in the chemical industries. With the return to normal business conditions and with the increased demand for men in valuation work we might expect a picking up in the registration of civil engineering students.

M. S. KETCHUM,
Dean, College of Engineering, University of Colorado.
Boulder, Col.

Sir: The accompanying diagram indicates the classification of engineering students at the University of Washington. As I see them, there are many reasons to account for the decline in civil engineering registration. Some of them are local, others apparently general. Among the local ones are:

1. Establishment of a school of forestry in 1907 and courses in architecture and commerce in 1914. The first two of these have drawn more from the department of civil engineering than any of the engineering departments.

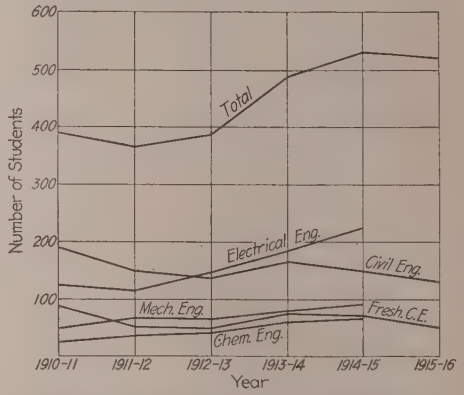
2. In the Pacific Northwest a great number of experienced railway men are working in subordinate positions, or are entirely without work.

3. Extensive hydroelectric development in this part of the country has been a factor in leading men toward the work in electrical engineering.

4. A couple of years ago a summer camp in surveying was announced for the department of civil engineering to begin in the summer of 1916. As a large proportion of our men depend upon remunerative work in the summers the move has not yet been considered a popular one.

5. Beginning with the present year, for the first time, a tuition fee has been charged for all departments.

As a general reason for the decline I would mention, but not emphasize, the over-supply of engineers in the country. I believe the question of over-supply is closely connected with the prescribed courses of study, and that in the decline is represented a protest against the present rigid requirements. I believe there is rightly a growing tendency to demand more flexibility in the education of the engineer, and that the work should include closer attention to the fundamental principles and an opportunity, through electives, of including a considerable amount of general training. If this should be provided, many of the engineering students would doubtless elect general courses in preference to the applied engineering work. The student body is sharp enough to see that much time is now being given to applied work in college, which could be picked up to much better advantage in practice. They are evidently noting the judgment of many of the leading engineers of the country, that the wrong things have been emphasized in college. They now seem ready to pay more attention to the fundamentals and to general training if the colleges make a revision of the curricula that will meet their views even half way. Personally I believe that this should and will be done.



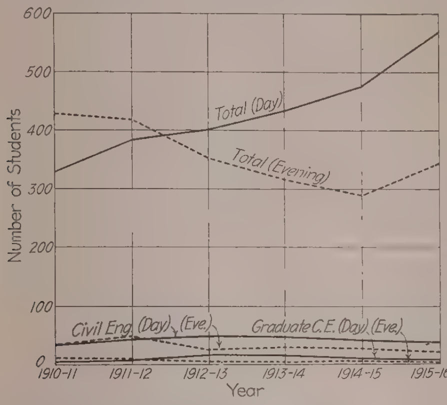
CLASSIFIED ENROLLMENT OF ENGINEERING STUDENTS AT UNIVERSITY OF WASHINGTON

I wish to call your attention to the fact that in your article on this subject of Dec. 18, two of the curves were labeled "University of Washington" and one of them "Washington State." They all followed up so closely the data which I am now sending that I believe they were all intended for the University of Washington rather than Washington State College, which is another institution.

I assure you of my appreciation of the interest your paper is taking in this subject.

ALMON H. FULLER,
Dean, College of Engineering, University of Washington.
Seattle.

Sir: I submit the accompanying figures showing the enrollment in the School of Applied Science of the Carnegie Institute of Technology, including the night school separately. Our students do not elect their professional courses until the end of the freshman year, so I cannot give the figures for freshmen civil engineers.



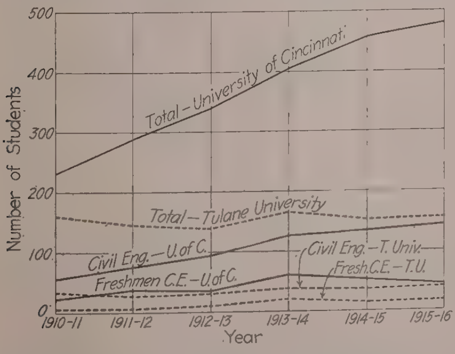
ENGINEERING ENROLLMENT IN BOTH DAY AND EVENING COURSES AT CARNEGIE INSTITUTE OF TECHNOLOGY

As regards reasons for changes in the number of students electing civil engineering, I venture the suggestion that while the total number of students in our engineering departments has been steadily increasing, the civil engineering department has not secured as large a proportion of the number as in the earlier years, because chemical engineering has been steadily becoming more and more important, particularly in the Pittsburgh district, and more students are now aware of the great field which this department of engineering has to offer.

Again, the establishment of a department of commercial engineering several years ago made an immediate impression upon the registration in the civil engineering department. I cannot see any reasons, other than the two mentioned, why our numbers in the civil engineering department should not increase proportionately.

WM. E. MOTT,
Professor of Civil Engineering, Carnegie Institute of Technology.
Pittsburgh.

Sir: The population of the State of Louisiana is small and we enroll relatively few students in the civil engineering course at Tulane University. Our enrollment has been increasing, as shown on the diagram herewith, although that in many institutions has shown a marked decrease.



ENGINEERING ENROLLMENT AT UNIVERSITY OF CINCINNATI AND TULANE UNIVERSITY OF LOUISIANA

The general decrease may be attributed to one or more of the following causes:

1. Higher entrance requirements.
2. Higher cost of education in many prominent institutions.
3. Increasing number of good small colleges.
4. Discouragement of prospective students by engineers who have not been successful on account of the ever increasing competition.
5. The higher educational requirements required for graduation in engineering, causing students to seek easier courses.
6. The subordination of mental training to highly specialized instruction confined to a limited field. Thus a student may be required to devote an excessive amount of time to drafting to the detriment of the time available for the study of the theory.

Our increase at Tulane is practically due to a reorganization of the department and making the civil engineering course as difficult as any other of the technical courses. The students feel that they are getting training that will be invaluable to them. One of the present seniors left a position paying $150 a month to return after an absence of two years in which he was accumulating money to pay his expenses and those of his family during this year.

We believe the success of our graduates to be one of the strongest influences in the maintenance of the number of our students.

W. H. P. CREIGHTON,
Dean, College of Technology, Tulane University of Louisiana.
New Orleans.

UNIVERSITY OF CINCINNATI enrollment in the co-operative courses in engineering is shown in the diagram herewith from figures furnished by Dean Schneider. The decrease in freshmen in civil engineering is due to the rejection of applications (which are always in excess of the number that can be accepted) in favor of chemical engineering students, in order to satisfy a largely increased demand from the co-operating firms for the latter class of students. The civil engineering enrollment is kept at about 25 per cent of the total.

Sir: I have read the article and editorial in the Engineering Record of Dec. 18 regarding the decline in registration of civil engineering students, and am sending a table showing the enrollment at the University of Minnesota. [The figures agree well with those already given in the original article, except for the three years, 1913 to 1915 inclusive. For these years the total engineering registration, not including the architects, is given as 390, 403 and 433, while the added figures for civil engineering students for those years are 149, 148 and 149.—EDITOR.]

The total registration of engineering students at Minnesota is on the increase since 1911-12. A falling off of the proportional registration of civil engineering students is barely perceptible. It will be found that the percentage which the latter bears to the total varies but slightly from 40 per cent in 1910 to 37 per cent in 1914. As to the reason for this, I would find it in the increased interest in electrical engineering. There is something so spectacular and in the nature of enchantment in electrical work that I find many young men coming into the college with the intent of becoming electrical engineers. The appeal to the imagination of youth is tremendous for this particular course.

Doubtless the rise of other courses such as forestry, architectural engineering, public health administration, and business administration will account for the lessened registration in engineering courses where the decline is present. I am not sure that the increase in the number of colleges which give engineering courses may not make the total registration of engineering students throughout the country equal to, if not in excess of, the registration of ten years ago.

As to the publicity given to engineers, it does appear to me that the successful completion of the Panama Canal has added a glamour to the civil engineering side of the profession, and that the newspapers, the magazines, fiction, the drama, and the movies are utilizing the engineer very fully as a hero. I believe never before has the engineer stood as high sociologically as to-day. I believe, moreover, that the compensation of engineers is on the increase, but I do believe the inducements of business into which so many mechanical and electrical engineers appear to go is sufficient to lure men from the early years of the practice of the profession. Large financial returns are for the maturer consulting and contracting engineers.

At Minnesota another element has entered to hold down the registration and that is our exceedingly high standard of scholarship. For instance, we eliminated last year sixty-one students out of a total student body of 475. High grade engineering schools care less now for numbers than formerly. A technical school's excellence is going to be determined by the really successful engineers which it graduates, and the accentuation of numbers is more of a play to the gallery than a real advantage. It is not improbable that some of our technical schools will follow the lead of our schools of medicine and surgery and limit the number of students whom they will accept.

FRANCIS C. SHENEHON,
Dean, College of Engineering, University of Minnesota.
Minneapolis.

Design of Turbine Draft Tubes

SIR:—I read the analytical discussion about the design of turbine draft tubes by A. G. Hillberg, which appeared in the Engineering Record of Nov. 13 and Nov. 20, 1915, pages 604 and 630 respectively, with special interest. In that treatment, however, there are some points which I cannot well understand.

In the first article, in the deductions of equation 7 he said:

$$v_{a+1} = y = \text{unknown velocity,}$$

$$\frac{2g}{\left(\frac{A_{a+1}}{A_a}\right)^2 - 1} = k = \text{a constant}$$

and

$$h_{a+1} - h_a = x = \text{change in static head,}$$

whence he derived an equation $y^2 = kx$, which represents a parabola.

In my opinion, however, the expression represented by k is not a constant, because A_{a+1}/A_a may not be a constant quantity. A_{a+1} is always inversely proportional to v_{a+1} or to y under the given discharge; that is,

$$A_{a+1} = Q/v_{a+1}$$

Substituting this value into equation 7,

$$v_{a+1}^2 = \frac{2g}{\left(\frac{Q}{A_a v_{a+1}}\right)^2 - 1}(h_{a+1} - h_a)$$

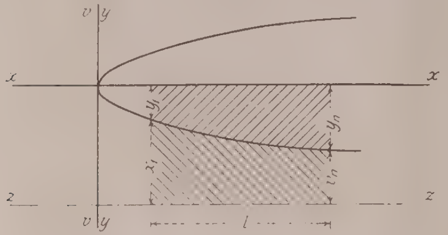
which can easily be changed into

$$v_{a+1}^2 = Q^2/A_a^2 - 2g(h_{a+1} - h_a)$$

Putting $v_{a+1} = y =$ unknown quantity, $(Q/A_a)^2 = a_0 =$ a constant, $2g = b_0$ = a constant, and $h_{a+1} - h_a = x =$ change in static head, we have

$$y^2 = a_0 - b_0 x$$

This is the same equation which can be obtained in substituting Q/A_a for v_a in equation 6, and quite different from equation 7. Thus, I think, it is necessary to assume that the ratio A_{a+1}/A_a is a constant, providing the change of static head is very small, to make the equation 7 rational.



In the same article, by shifting the coordinate axes, the author obtained an equation $v = b - \sqrt{kz}$, the Z-axis representing the length of the center line of the draft tube; and considering the fact that $v_1 + v_n = y_1 + y_n$, he obtained the results $v_1 = y_n$, $v_n = y_1$ and $b = v_1 + v_n$. This is graphically represented by the accompanying figure. It shows that the variations of the static head is proportional to the change of the center-line length of the draft tube, and I think it cannot be true except in the case of a vertical draft tube.

T. Kitazawa,
Professor of Civil Engineering, Nagoya Technological College.
Nagoya, Japan.

[The foregoing letter was referred to Mr. Hillberg, who replies as follows:—Editor.]

Sir:—Professor Kitazawa is correct in his observation that the term A_{a+1}/A_a is variable, thus making the term

$$\frac{2g}{(A_{a+1}/A_a)^2 - 1}$$

a variable also. But if the variation in the value of A_{a+1}/A_a is analyzed, it is found to be so slight as to be negligible, especially in the upper part of the draft tube.

If the reader looks at the table accompanying the second part of my article this statement is easily verified, but it must be borne in mind that the areas given in that table have been calculated on the principle of a parabolic retardation of the velocity in the draft tube, and that, therefore, the apparent variation of A_{a+1}/A_a is greater than it actually would be had the equation

$$v_{a+1}^2 = \frac{2g}{\left(\frac{A_{a+1}}{A_a}\right)^2 - 1}(h_{a+1} - h_a)$$

been used. The writer does not deny that it would have been more correct to use that equation instead of equation 7, but, unfortunately, certain complications found in establishing the relation between the areas made it easier to determine the change in velocity instead. This explains also why after having started with a definite assumption that

$$(v_a^2/2g) - (v_{a+1}^2/2g) = h_{a+1} - h_a$$

which, of course, is true for only one shape of the draft tube, it has been found necessary to analyze three different cases, viz.,

$$v_1 + v_n \overset{>}{\underset{<}{=}} y_1 + y_n$$

It has, furthermore, been shown that the case $v_1 + v_n = y_1 + y_n$ does not absolutely satisfy the condition that the change in velocity head should, for the maximum discharge, equal the change in static elevation, as it makes the change in the former somewhat smaller than that in the latter. This, however, is entirely on the safe side.

Professor Kitazawa shows how the equation

$$v_{a+1}^2 = (Q/A_a)^2 - 2g(h_{a+1} - h_a)$$

can be derived. He then states that $(Q/A_a)^2 = a_0 =$ a constant, but this is incorrect. The size of the area A_a depends upon its location and the corresponding velocity at that point, and it is thus a variable, while Q is a constant. Consequently, the equation $y^2 = a_0 - b_0 x$ has three variables, y, a_0 and x, which make it rather inconvenient to handle. In order to solve it analytically it is necessary to derive a second equation containing the same variables and to eliminate one of the three. It can, however, be solved by a few trials made under assumptions similar to cases 1, 2 and 3 used in solving the equation $y = b - \sqrt{kz}$ in my article.

As to the second part of Professor Kitazawa's letter, I beg to point out that the equation $v = b - \sqrt{kz}$, where $b = v_1 + v_n$ and $k = (v_1^2 - v_n^2)/l$, has nothing whatever to do with the *shape* of the center line of the draft tube. It merely states that the velocity at any point on the center line is a function of the distance of this point from a certain axis.

In the part of the article, published in the issue of Nov. 20, page 630, there are two apparent mistakes in the illustrations. The dimension 23 ft., as explained in the text, gives the difference in elevation, between the lowest tailwater level and the top of the runner band. On Figs. 6 and 7, however, the dimension lines have not been extended up to the line marked top of runner band, but have been terminated on a line located 5.3 ft. below it.

A. G. Hillberg.
New York City.

The Economic Side of Sand Testing

Sir: The undersigned has recently had occasion to review in some detail the excellent articles on "The Economic Side of Sand Testing" by Cloyd M. Chapman and Nathan C. Johnson published in the Engineering Record in the issues of June 12, 19 and 26, 1915. These articles are now running in the Sibley *Journal of Engineering*.

In the first article of the series the authors gave a practical application of the use of a blended fine aggregate formed by adding stone screenings to a fine sand, resulting in a product cheaper and of much better quality than when the sand is used alone. By the use of this "blended material" a saving of $21,380 was effected on a certain work.

The proportion of fine sand and screenings was determined by using Fuller's maximum density curve as a model and approximating it as closely as possible with the curve of the blended mixture. The writer respectfully calls attention to the fact that inasmuch as Fuller's maximum density curve represents a mixture of *cement* and aggregate and not of aggregate alone, as used by the authors, it follows that some other combination of fine sand "B" (see their Fig. 2 on page 735 of the issue of June 12, 1915) and stone screenings would give, *when mixed with cement*, a closer approximation to the ideal curve.

The writer finds that this is accomplished by using 7 per cent of sand "B" and 93 per cent of stone screenings instead of 28 per cent and 72 per cent respectively as used by the authors. In the accompanying chart of sieve analysis curves, curve No. 1 is the curve of the cement alone, No. 2 is the "B" sand, No. 3 is the stone screenings, No. 7 is Fuller's maximum density curve as the authors used it, No. 6 is Fuller's curve as derived by the writer, using Fuller's constants for sand and crushed rock. Curve No. 5 is the mixture of *cement* and the authors' blend of "B" sand and stone screenings. Curve No. 4 is the mixture of *cement* and the blend of "B" sand and stone screenings which would give a closer approximation of mixture to Fuller's ideal curve.

Using the same reasoning as the authors, if Fuller's theory is right, curve No. 4 should give greater density and strength than curve No. 5. To ascertain if this be so the writer has made density and strength tests in which the "B" sand and stone screenings used were graded exactly as the same materials shown by the authors' curves. The results are given in the accompanying table, in which each value is the average of three tests.

Tests of 2 x 2-In. Cubes in Compression at Age of Eight Days

Aggregate used	Density of mortar	Compressive strength, lb. per. sq. in.	Per cent water
"B" sand	0.695	1162	14.0
Chapman and Johnson's blend.	0.798	3612	10.8
Writer's blend ...	0.828	4126	9.8

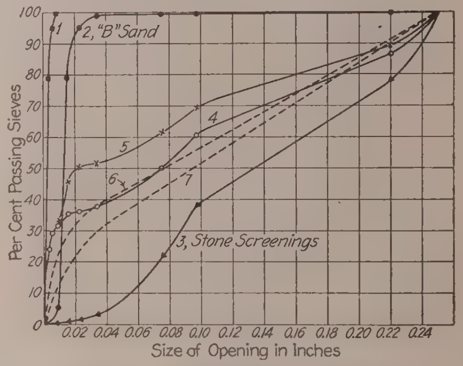


CHART OF SIEVE ANALYSIS CURVES

The methods used were similar to those used by Mr. Fuller in the original investigation. Mortar volume was read to 0.0001 cu. ft. The specific gravity of the sand was 2.645, of the screenings 2.63. The cement was a mixture of Alpha, Atlas, Lehigh, Universal and Wabash. The proportion of cement to total aggregate was the same in all cases—1 to 2.2 by weight.

Using the same assumptions that the authors did and the same method of computation, the saving amounts to $28,116. This is $6,736 more than that obtained by the authors.

H. H. Scofield,
Instructor in Testing Materials, Purdue University.
West Lafayette, Ind.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Plaster of Paris Holds Joint Mortar Exposed to Tidal Currents

IN BUILDING sea walls of coursed masonry laid in mortar and exposed to the action of tidal currents, where the bottom course is not more than a foot above mean low water, much difficulty is often encountered in holding the mortar in the joints long enough to give it time to set, as the action of the tides on the fresh mortar will pull it out of place. It does not matter how rich a mixture is used, whether 1:1 or neat cement, it is impossible to keep the mortar in place until it hardens.

On one piece of construction, under the supervision of John L. Howard, assistant engineer, Directors of the Port of Boston, this difficulty was successfully overcome by mixing plaster of Paris with the mortar in the proportion of one part of plaster of Paris to three parts of 1:1 mortar. This mixture hardened within five minutes, and no further trouble was experienced from the mortar in the joints failing to set in place. The pointing of the joints in which this mixture had been used was entirely satisfactory. The method is described by Mr. Howard in the current *Papers and Discussions* of the Boston Society of Civil Engineers.

Ceiling Hooks and Lockers Good Combination for Wash House

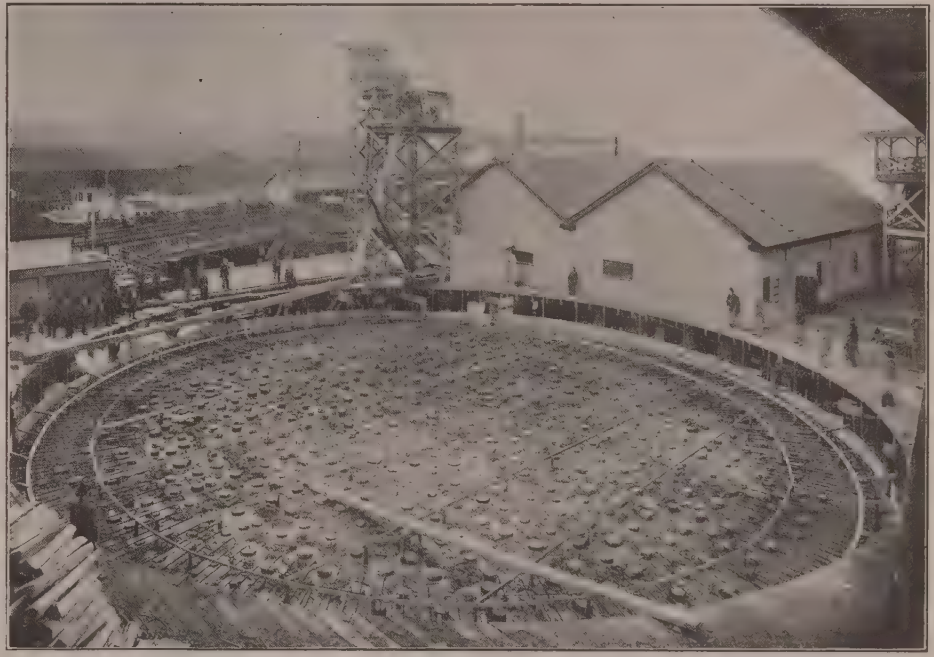
CEILING hooks on which working clothes can be hung and drawn up out of the way, combined with lockers at the floor level in which the men's street clothes can be kept, are recommended by Joseph H. White in a paper on miner's wash and change houses recently issued by the Bureau of Mines. The hooks are fastened to chains running over pulleys at the ceiling and in the top of the locker, in one arrangement, and unless the locker is opened the chain cannot be revolved. The scheme keeps the working clothes, which give off bad odors and soon make a locker offensive, next the roof, where a simple ventilating system can be installed to take the foul air out of the room. The clothes also dry much more quickly in this way.

Contractors who employ "sandhogs" on long jobs, and other workmen for whom wash and change facilities are needed, will find valuable suggestions in this pamphlet (known as technical paper 116), on the arrangement and construction of such houses. For instance, figures are quoted to show that less water and steam is needed if the combination of taps over a long trough for washing the face and hands and inclosed shower baths for washing the body is used. The experience of many mines has shown that it pays to have a first-class man as caretaker, and that, if soap and towels are furnished, and if a small charge is made for the use of the place, the men take better care of it, and maintenance in a sanitary condition is cheaper. A suggestion on this line is the installation of a wash tub or two, to prevent the men from washing out dirty clothes in the bathing places.

Mounting of Mixer Lowers the Cost on Tank Foundation and Wall

By CHARLES BENTALL
Vancouver, B. C.

ON THE oil-tank construction work shown in the accompanying photograph the mixer was mounted at the right height to dump into buggies on a runway at the top of the fire wall surrounding the tank, and at the same time was able to spout concrete directly into the tank foundation. The mixer was placed on a tower at the edge of the wharf so that the extension loading skip could be lowered to the deck of the barge at any stage of the 12-ft. tide. The sand and gravel were proportioned at the pit and delivered on barges carrying also the right quantity of cement, which saved time in handling.



MIXER INSTALLATION WAS ONLY PLANT NEEDED TO COMPLETE 1000-YARD CONCRETE JOB

The 30,000-bbl. oil tank, the work on which is described, was built at the Grand Trunk Pacific Railway wharf at Vancouver for the Imperial Oil Company, Ltd. After the piling was all in place the hoisting tower was erected and the hoist motor put in place. The beams supporting the sheaves at the top of the tower were made longer than usual, and temporarily placed at the extreme top, being allowed to project over the mixer platform. The mixer and its motor were then hoisted in a few minutes by the hoist motor. By making the height of the mixer platform such that it discharged directly into buggies at the top of the fire-wall form, and such that at the same time it was high enough to spout directly the concrete for the 2-ft. thick tank foundation, the entire concrete work was handled without requiring any derricks or other plant except the mixer installation.

The concrete materials were delivered by scow from the gravel pit. On this scow was placed the cement, which was delivered by water from the cement mills. The hoisting skip for charging the mixer was loaded by wheelbarrows with the correct amount of aggregate and two sacks of cement direct from the deck of the scow. The specifications for the concrete in the foundation slab called for a 1:3:5 mixture. It was found that 3 cu. ft. of the sand and 5 cu. ft. of the gravel used measured 7 cu. ft. when thoroughly mixed. By discharging the correct amount of sand and gravel from different hoppers at the gravel pit upon a belt which loaded the scows, it was possible to mix the sand and gravel dry as it was loaded. This saved time at the job, and also allowed the scows to be loaded more heavily, as the mixture occupied less space than the same quantity of materials loaded separately. The work was done by the Dominion Construction Company, Limited, of which the writer is engineer.

Making Asphalt Expansion Joints on a Plank Saves Time

By R. C. HARDMAN
Colorado Springs, Col.

EXPANSION joints in concrete are often made of asphalt or similar material applied to the concrete surface by means of a brush until a sufficient thickness is obtained. In other cases, especially in thin slabs, an open joint is formed by means of a wooden strip and later filled by pouring with hot asphalt. The writer has used two methods having many advantages over this practice, one of which consists in preparing sheets of the proper size and shape. The sheets are made on a plain surface of 1-in. lumber. Upon this is placed cheap building paper held in place by laths which also serve the purpose of determining the shape and thickness of the sheet. If the section to be covered is comparatively small the sheet may be made of the exact shape, while, if large, rectangular sheets are better. These may be cut to fit the exact section very easily, especially in cool weather. The sheets may be made of any desired thickness, although the thinner sheets are more easily handled. In placing these sheets they are merely nailed to the green concrete, or otherwise fastened if the concrete is too hard for nailing. This method is economical of asphalt compared with the cruder method of painting, and in addition secures a perfectly uniform thickness and a cleaner job. For thin floor sections a good device for forming open joints consists of a narrow trough formed from galvanized sheet metal. The bottom width is ¾ in. and the top width is made convenient for easy withdrawal. The sheet metal strips are made in sections about 8 ft. in length and furnished with three sets of handles. Wood wedges are placed close enough together inside the trough to prevent undue springing of the metal. This springing is also provided against by rolling the top edges. After the concrete is sufficiently set the wedges are knocked out and the metal strips withdrawn.

Steam Shovel, Crusher and Pumps Put Hydraulic Fill in Dam

INTEREST was directed to the San Fernando dam as a unit in the Los Angeles water supply system when it was announced that this structure was being built of material pumped into place at an overall cost of 7 cents per cubic yard. The process used, which was described in the Engineering Record of July 11, 1914, was continued until the increasing height of the dam and the lengthening of the pipe lines made it desirable to secure material from a higher level. Further study of the vicinity then developed the fact that a solidly packed material carrying 30 per cent of fine clay was available on the north side of the east end of the dam. This was, however, too firm to be handled effectively by the hydraulic giant methods previously employed and it was decided to excavate it from the bank by a steam shovel, which would load into dump wagons, these in turn delivering to a sump from which the material could be pumped to the desired location on the dam.

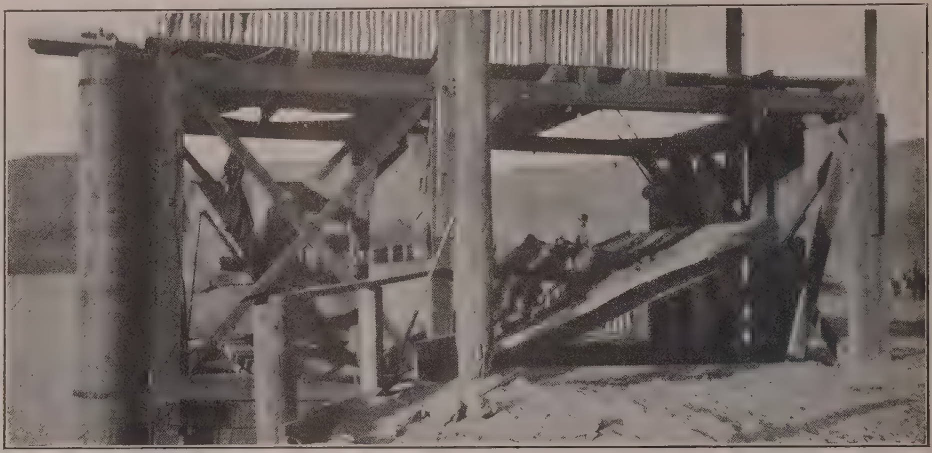
It was found, however, that in order to secure effective handling by means of the pumps, some means of crushing the material would be necessary, and rolls for this purpose were accordingly designed. These were installed so that their function could be performed after the time the material left the dump wagons and before it was picked up by the suction pipe.

Crushing and Pumping

In one of the accompanying illustrations the entire layout of the system is shown. The steam shovel in the background delivers to 1¼-cu. yd. dump wagons which have an average haul of 500 ft., and dump their loads on a hinged platform. To one edge of this platform are attached cables operated by electric motor and by which it is tilted so the material slides off into a hopper over the rolls. The average capacity of the steam shovel and the wagons which serve it is about 1500 1¼-cu.-yd. loads for each day of two 8-hr. shifts. On unusually favorable days, however, the output has been as high as 2294 loads for two shifts.

The rolls are made of solid cast iron 36 in. in length and are hung on a 5-in. shaft. Each roll is equipped with 36 teeth arranged in six rows of six teeth each. These teeth are 2 in. square and 7 in. long. They are made of tempered tool steel and are fixed in the rolls so that about 2½ in. project. The rolls are so placed that the distance between the projecting ends of the teeth can be varied from 5 in. down to bare clearance. Each row of six teeth is held in place in its roll by means of a rod running parallel to the axle and fitting in the slot with which each tooth is provided. A single 75-hp. motor is connected so that direct drive is transmitted to each shaft. In order to provide for the shocks which would otherwise affect the motor a 1500-lb. fly wheel is mounted on the shaft of each roll.

From the rolls the material is dropped into a 10 x 10-ft. sump, into which water from the reservoir has free access so that the supply is continuous. A 12-in. suction pipe extending into this sump connects with a Byron Jackson sand and gravel pump, the rated capacity of which is about 450 cu. ft. per minute under a head of 50 ft., allowing for about 20 per cent of solid material.



PLATFORM THAT WAGONS DUMP ON TILTS AFTER THEY LEAVE IT, SLIDING CLAY TO CRUISERS

At the present time the material is being lifted a total distance of 52 ft. in two stages, pumps of the same capacity being installed for each stage. The length of delivery ranges from 500 to 2000 ft., according to the point on the dam where the material is required.

The work is being done under the direction of William Mulholland, chief engineer, Bureau of Waterworks and Supply. Fred J. Fischer, chief mechanical engineer, is in charge of the design and construction of the crushing and pumping plant.

HYDRAULIC FILL AT TOP OF THIS DAM DUG BY STEAM SHOVEL, HAULED IN WAGONS, CRUSHED AND PUMPED TO PLACE

130,149,368 CU. YD. of rock and earth were excavated up to the beginning of the present fiscal year on the projects of the U. S. Reclamation Service.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Bridges Washed Out and Roads Damaged in Southern California

Serious damage was inflicted in all Southern California counties as a result of the heavy rainfall beginning Jan. 26. The $25,000 reinforced-concrete bridge across the San Diego River, completed about a year ago, was completely wrecked. The Santa Fé Railroad bridge across the same stream was also washed out. The reinforced-concrete highway bridge over Sycamore Creek in San Diego County and the steel girder bridge with three 40-ft. spans on San Juan Creek in Orange County went out.

Atogether the state highway damage was three times that suffered during the storm of the preceding week, according to highway officials, due to saturated soil conditions when the second storm began. County bridges and roads throughout all Southern California suffered even more heavily than state highways. A break occurred in the million dollar Los Angeles outfall sewer near Inglewood, and temporary repairs were hastily made. A dam above Vannuys failed, causing a small flood in that city.

Pennsylvania Railroad to Build Hotel in New York City

The Pennsylvania Railroad is making plans for the construction of a 12-story hotel on its site opposite the Pennsylvania Station on Seventh Avenue, between Thirty-second and Thirty-third Streets, in New York City. It is understood that a total of $9,000,000 will be invested in the project, the hotel to cost about $5,000,000, with the expectation of starting a building boom which will affect the entire Pennsylvania Station zone. The building will occupy most of the site of 198 ft. x 400 ft. already owned by the railroad. The details of size, height and capacity are not yet fully decided. Tentative plans for the structure are being prepared under the direction of McKim, Mead and White, architects, of New York City. It is hoped to complete the new building by the time the Seventh Avenue subway is in operation.

To Build Government Locomotive Plant at Petrograd, Russia

Alphonse I. Lipetz, chief of the locomotive division of the Imperial Russian Railway Administration, has been studying locomotive plants in this country, with a view to obtaining information to be used in the design of a plant at Petrograd, which he will have charge of. Work on the plant will be started as soon as he returns to that country.

Connecticut Utilities Companies Claim Earnings Tax Deductions

Attorney-General Hinman of the State of Connecticut has filed suits in the Superior Courts against the United Electric Light & Water Company, of Waterbury, and the Fountain Water Company, of Ansonia, for non-payment of State taxes under the terms of the miscellaneous corporations tax law. The cases will be taken at once to the Supreme Court of the state for final adjudication.

The tax which is being fought is one of 1½ per cent on the gross earnings from operations in the state, with no deductions to be made from the earnings before the tax is computed. The two defendant companies paid only a part of the tax, having deducted certain of their earnings.

The defendant companies claim that "deductions should be allowed from the amount of gross earnings for earnings derived from operations incidental to the main business of the company, for payments made from capital for the purchase of raw materials and for operating expenses.

The Supreme Court's decision will affect forty gas, electric light and water power companies in the state, in which a large portion of the stock is held by outside investors.

Subcontractors on Rogers Pass Tunnel Win Suit for Bonus

Damages for breach of contract in connection with construction work on the Canadian Pacific Railway tunnel at Rogers Pass were recently awarded McIlwee & Sons, of Denver, Col., in their claim against Foley Bros., Welch & Stewart, of Vancouver, B. C., by a judgment of the Privy Council, delivered in London, England. The exact amount of damages has not yet been decided, but it is reported that the council upheld the principle that McIlwee & Sons were entitled to full damages, including profits, just as if they had been allowed to complete the contract.

After Foley Bros., Welch & Stewart secured the contract for boring the five-mile tunnel at Rogers Pass, they sublet the contract for the pioneer and center headings to McIlwee & Sons, offering as a special inducement for rapid work a bonus of $1,000 a foot for every foot over a stipulated advance to be made each month. McIlwee & Sons began work and made such rapid progress that at the end of three months they had a claim for bonus amounting to over $200,000. Difficulties then arose between the engineers on the work and McIlwee & Sons were ordered to stop work and vacate the contract for alleged refusal to obey the orders of Foley Brothers' engineers. After a period of six weeks permission was given to McIlwee & Sons to resume work, but instead they quit work entirely and brought suit for $500,000 for breach of contract. This amount was later increased to $800,000.

Will Construct Double-Track System in Cincinnati Loop

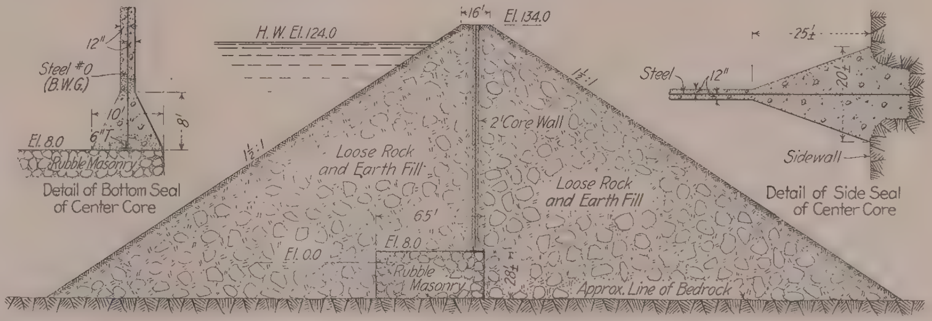
The Cincinnati Rapid Transit Commission, at a meeting held Jan. 22, decided to construct a double-track system for the proposed loop of the rapid transit and interurban railway project of that city.

Interurbans will be permitted to enter the loop and bring their cars to the heart of the city. Freight cars will also be moved over the loop. All passenger cars operated over the loop will be required to be of metal construction.

Otay Rock-Fill Dam Near San Diego Fails

Flood Devastates Valley and Sweeps Path Two Miles Wide When Structure with Steel Plate Core Goes Out

Late in the afternoon, Jan. 27, the lower Otay dam on Otay Creek, 22 miles southeast of San Diego, Cal., failed when, probably for the first time in its history, the water rose to its spillway 125 ft. above the stream bed level. The recent heavy rain storms in southern California, reported last week, followed by a storm which began on Jan. 26 and resulted in about 2.5 in. rainfall, filled the reservoir to the crest. Thirteen billion gallons of water suddenly released down the Otay Valley when the dam broke devastated a strip of rich farming land about two miles wide and fifteen miles long. It is estimated that forty lives were lost and $1,000,000 worth of property damaged.



CROSS-SECTION OF LOWER OTAY DAM

DIMENSIONS AND DETAILS OF CONSTRUCTION OF LOWER OTAY DAM WHICH FAILED

The lower Otay rock-fill dam was of unique type, containing a thin core wall of concrete 2 ft. thick, in the center of which was embedded a ¼-in. steel plate. It was the first of its kind ever constructed. Work started in 1887 and was completed in 1897, for the Southern California Mountain Water Company. The reservoir supplies water to San Diego and Coronado, and had been taken over by the city of San Diego. While this source of supply is cut off, the cities are being served by the Cuyamaca water system, whose lines connect with the city mains.

The dam was built on bed-rock foundation of seamy porphyry. The dimensions are shown in the accompanying drawing from the *Transactions* of the American Society of Civil Engineers, Vol. 75, page 30, in a paper by M. M. O'Shaughnessy on "Construction of the Morena Rock-Fill Dam, San Diego, Cal." The base of rubble masonry about 28 ft. high and 160 ft. long, was originally constructed with the intention of making a solid masonry dam throughout. The cost, however, appeared excessive to the owners who changed to a rock-fill type with the steel plate and concrete core wall. The top of the dam is about 600 ft. long, the total height being 150 ft. At previous stages in its history, when the water rose to high levels, the resulting saturation of the soft materials, mixed with the rock from nearby quarries used for the fill, caused a slight settlement of the upstream side. There has always been a slight leakage, varying with the head of water on the dam. The area of the watershed is only about 100 sq. miles, and usually the precipitation is light.

The steel plate in the core was riveted to a heavy 6-in. T, anchored to the top of the masonry foundation by 1-in. bolts. The lower sections were 5 ft. wide and 17 ft. 6 in. long, the three bottom courses being 0.33 in. thick.

From 28 to 50 ft. in height the thickness was ¼ in. and above 50 ft. the plates were 8 ft. wide and 20 ft. long, decreasing in thickness toward the top. After riveting, the plates were caulked on the upstream side and coated with hot asphalt, covered with burlap while still hot, and then encased by the 12-in. concrete layer on each side. The wooden forms used were not removed, so that the rock fill could settle independently of the core wall. When completed the top of the wall was in very irregular alignment. Further details of the construction will be found in the Engineering Record of Sept. 28, 1895, page 310, and June 27, 1896, page 64.

The spillway was a few hundred feet from the east end of the dam and had a channel 30 ft. wide with a maximum depth of 30 ft., being 10 ft. below the crest. No outlets or pipes were built through or under the dam proper, but an outlet tunnel was built about 1000 ft. west of the dam through a narrow part of the enclosing ridge. The failure is, therefore, not due to seepage.

The following rainfall data has been received from the U. S. Weather Bureau's Washington office:

Rain set in over southern California on the night of Jan. 26. On the morning of Jan. 27 the following-named amounts were reported: San Luis Obispo, 1.46 in.; Los Angeles, 0.96 in.; San Diego, 1.04 in. On the evening of Jan. 27 the amounts were: San Luis Obispo, 2.08 in.; Los Angeles, 1.62 in.

Communication by telegraph with San Diego was lost during Jan. 27 and was not restored until Jan. 31. It is clear, however, that the rain ended on Jan. 27; that the total fall of the storm was probably not greatly in excess of 2.50 in., since the amount recorded at Los Angeles was but 2.58 in.

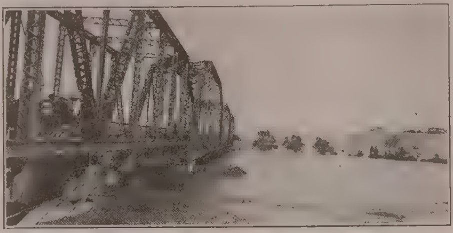
700-Ft. Bridge in Arizona Left High and Dry by Floods

Further details in regard to the flood of Jan. 22 in Arizona indicate that the damages to the State road system were, as was indicated in the first reports published in these columns last week comparatively slight. The 700-ft. concrete bridge over the Gila River at Florence was left high and dry, the river having cut a new channel for itself. Works of the U. S. Reclammation Service were damaged to the extent of from $50,000 to $75,000.

In the Indian Reservation approximately 10,000 acres of land, of which about three-fourths was in cultivation, was flooded, and the Southern Pacific main line, which crosses the tract, was washed out in several places. In the Yuma Valley about 3000 acres of land were flooded, and the damage to the Reclamation Service works is probably between $50,000 and $75,000. The Southern Pacific, city of Yuma, and farmers' damage were each of greater amount. Reconstruction of the damaged levee and canals is being pushed rapidly with a view to having the minimum interruption to water service. The total damage done by the floods, according to conservative estimates amounted to over $1,500,000.

FLOOD WATERS COVERED 10,000 ACRES OF LAND IN THE INDIAN RESERVATION

The state highway concrete bridge across the Gila River at Florence, a 700-ft. structure completed in 1910, was left high and dry by the river, which cut a new channel 900 ft. wide through the south approach. While the damage has not yet been investigated by the state engineering department, it is believed from reports received that it may be necessary to extend the bridge for that distance in order to restore the crossing. Meanwhile travelers are being ferried across the river in boats. The state highway bridge over the Gila at Wellton, completed last year, was not damaged by the flood, save in the washing out of the north approach, which had not been completed.


RIVER REACHED HIGHEST LEVEL RECORDED SINCE 1891 AT RAILROAD BRIDGE AT YUMA

Bridges on the Roosevelt highway were washed out, and it is estimated that 4½ miles of the road will have to re-surfaced. It will be months before the highway can be opened for travel, except for light wagons, according to the report of Reclamation Service engineers.

During the floods, the overflow at the Roosevelt dam mounted to over 11 ft. of water over each of the 200-ft. spillways. Although 5 ft. over the spillways was the largest amount expected when the dam was designed, it is said that no effects from the recent heavy pressure were evident.

Subsidiary power plants in the Salt River Valley were forced to suspend operations during the flood owing to water backing up into canals, or to the fact that several canals were emptied in order to carry off flood waters.

Indiana Public Service Commission Fixes Rates for Hydrant Service

The Indiana Public Service Company of Aurora, Ind., has been ordered by the public service commission of that state to charge the following rates for private fire protection service from its water plant. Maintaining pressure for private fire sprinkling systems, connection 6 in. or over, $50 per annum; 4 in. connections, $45; private fire hydrants installed and maintained by the individual, 2 in. hose connection, $18 per year per hydrant; private fire hydrants installed and maintained by the individual, 2½ in. hose connection, $20 per hydrant.

Water System at Anchorage

The Alaskan Engineering Commission has completed the new water system at Anchorage, Alaska, and turned the water into the mains on Jan. 19, thereby ending a water shortage which began last November when freezing weather set in. Anchorage is the base of supplies for the government railroad now under construction.

Water Power Development Three Times as Fast as Steam

Secretary of Agriculture States That Eighteen Corporations Control More Than One-Half of Water Power in Public Service

In a special report submitted to the Senate, Jan. 20, by the Secretary of Agriculture it is stated that eighteen corporations control more than one-half of the total water power used in public service operations in this country. Eighty per cent of the total installed power in 1912 was steam power, but since then the per cent of increase in water power development has been three times as great as in steam power. The power developments which utilize national forest lands have 42 per cent of the total developed power of the Western states.

Tendency Towards Association of Interests

In his report, Secretary of Agriculture Houston presents, in far greater detail than has ever been attempted before, an exhaustive analysis of the general power situation, which shows that eighteen corporations control more than one-half of the total water power used in public-service operations in the United States, while six corporations control more than one-quarter. The data show, it is stated, a marked tendency toward association or community of interests, particularly between the principal holding companies.

Of all the primary power employed in the electrical industries and in manufactures in 1902, 11.2 per cent was installed in commercial central stations. The proportion had risen to 23.8 per cent in 1912, more than doubling in ten years. The movement toward concentration is found in all sections of the country. From 1902 to 1912, the rate of concentration was highest in the South Atlantic states, which had three times as great a proportion of primary power in commercial stations in 1912 as in 1902. The extent of concentration was greatest in the Western states. Fifty per cent of all primary power of all kinds in the Mountain states in 1912 was owned by public-service corporations; 54 per cent in the Pacific states. In California the proportion was three-fourths. To-day public-service corporations own 90 per cent of all the primary power in these two groups of states.

Water Power Resources of Country

Revised figures of the potential water-power resources of the country place them, the report states, at a minimum of 27,943,000 hp. and a maximum of 53,905,000 hp., the minimum representing the amount of power that could be developed from the use of the average annual minimum stream flow for the lowest two consecutive seven-day periods of each year, while the maximum represents the amount that could be developed from the use of the average maximum continuous stream flow available for six months during the year. The national forests are stated to contain 30.4 per cent of this minimum and 31.3 per cent of the maximum, while over 72 per cent of the country's total is found in the Mountain and Pacific states, and 42 per cent in the three Pacific Coast states. National forest water power amounts to 42 per cent of the minimum and 43 per cent of the maximum estimated power resources of the Western states.

While 80 per cent of the total installed power from all sources in 1912 was steam power, and while nearly three-fourths of the total primary power installed in commercial and municipal central stations, and in street and electric railway plants was steam power, the preponderance of steam power is found, according to the figures given, in the Eastern states; and the per cent of increase in water-power development for public service use, in the three years since 1912, has been three times as great as in steam power. Primary power installation from all sources and for all uses increased, in the eleven Western states, 240 per cent from 1902 to 1912, or more than two and one-half times as rapidly as in the remainder of the United States. This includes primary power used directly in manufactures, 94 per cent of which is found in the Central and Eastern states.

Primary electric power increased in the Western states between 1902 and 1912, 440 per cent, as against 226 per cent in the remainder of the country, while the development per capita in the Western states in 1912 was two and one-half times as great as in the remainder of the United States. In installed water power per capita the Western states had more than four times as much in 1912 as the remainder of the United States. There is at the present time a considerable over-development in nearly all the power centers of the Western states, California, Oregon, and Washington in particular showing installations far in excess of maximum demands.

Private power interests reported in 1912 a total investment, as represented by the item "Cost of Construction," of over $2,000,000,000, equivalent to $21.97 per capita, and to an average of $301 per horsepower of primary installation. Municipal stations reported an aggregate cost of $77,000,000 and a cost per horsepower installed of $138, or considerably less than one-half of the reported cost of commercial stations. This apparent discrepancy in favor of publicly-owned enterprises is explained as probably due in main to financial statements by the commercial stations in which "cost of construction, equipment, and real estate" represented not actual outlays, but the amount which will make assets balance liabilities. "In the majority of cases," says the report, "it would be more nearly correct to call this item 'assumed present value of properties,' than to call it 'investment in' or 'cost of' such properties."

The power developments which utilize National forest lands have 42 per cent of the total developed power of the Western states, 30 per cent through occupancy with some part of the immediate generating plant and 12 per cent through storage reservoirs. An additional 14 per cent either occupies public lands outside the forests or depends directly upon storage reservoirs upon such lands, making 56 per cent of the total developed water power of the Western states dependent upon the use of public lands, taking place under existing laws. Plants either now under construction or for which final permits have been taken out will provide a further increase equivalent to 20 per cent of the total present Western water power development.

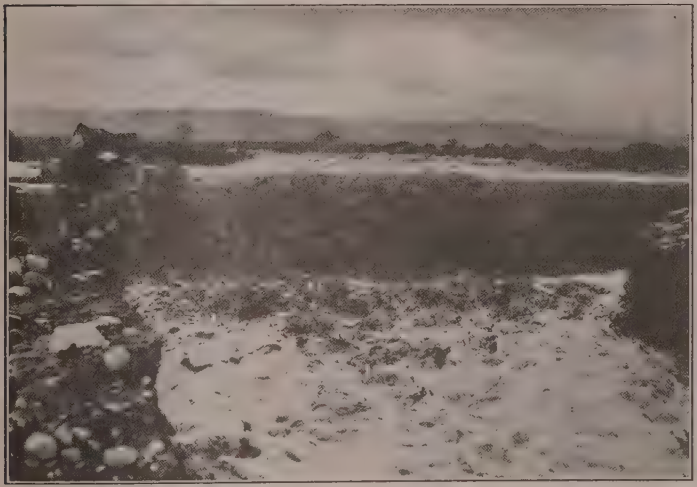
Engineers Organize Preparedness Lectures Under Army Supervision

Captains in Corps of Engineers to Instruct Technical Men Preparatory to Organization of Training Camp at Plattsburg Next Summer

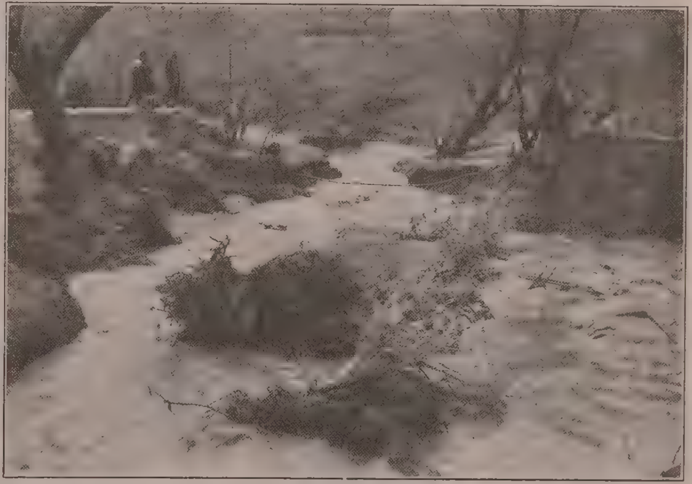
With the cooperation of Maj.-Gen. Leonard Wood, U. S. Army, a voluntary committee of representatives of the four national engineering societies have organized a series of seven military lectures to begin this month in the auditorium of the Engineering Societies Building, 29 West Thirty-ninth Street, New York City. These lectures are intended to serve as a preliminary to field instruction at an engineering camps to be held at Plattsburg, N. Y., next summer. The speakers are all captains in the U. S. Army Engineer Corps. The schedule of dates and subjects follows:

Feb. 14—Subject: Organization and duties of engineers in war, and what engineers in civil life will be called upon to do in the defense of the United States. Speaker, Capt. Thomas M. Robins, Corps of Engineers.

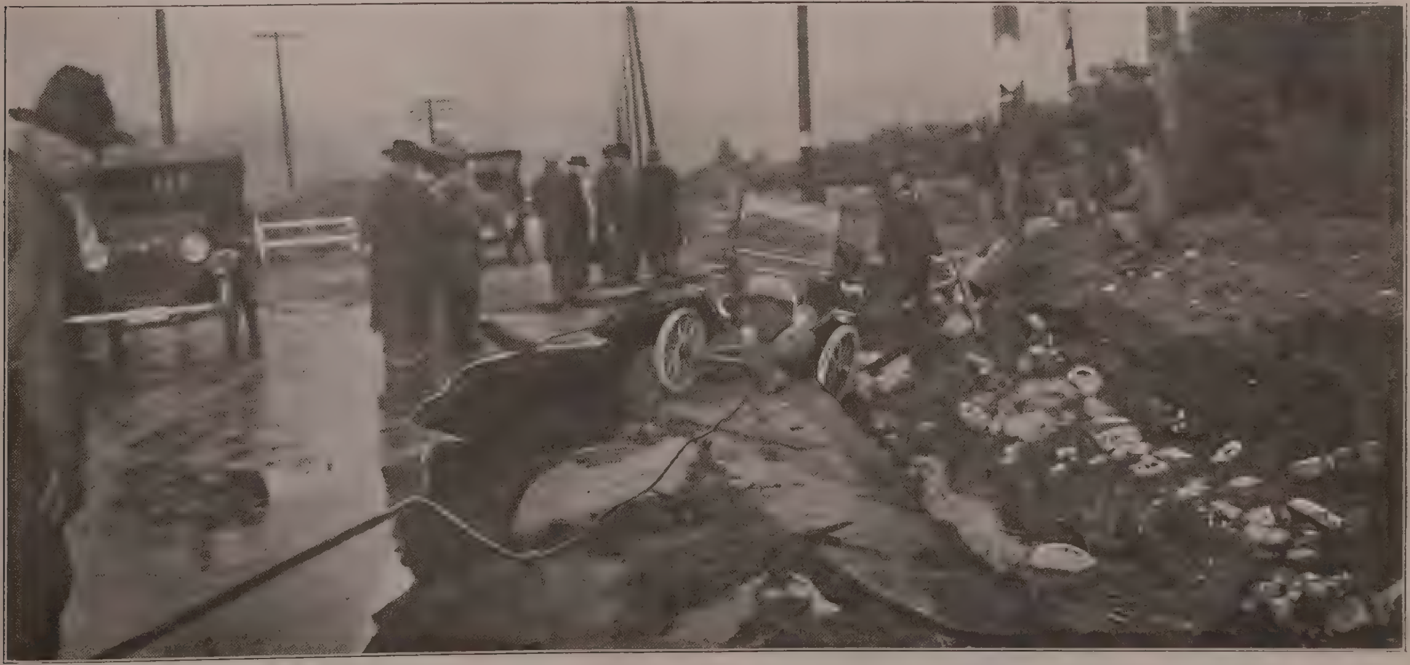
Recent Floods in California Damage Streets and Tear Up Valuable Lands in Pomona



SAN ANTONIO WASH BREAKS BANKS NEAR CLAREMONT AND TEARS UP ORANGE GROVES IN THE VICINITY OF POMONA



CITY RECREATION PARK AT POMONA SUFFERS SEVERELY FROM FLOOD WATERS, WHICH MAKE NEW COURSES THROUGH IT



NEW ASPHALT STREET AT POMONA UNDERMINED FOR AT LEAST A HALF MILE, DAMAGING PAVEMENT TO A VALUE OF $15,000

Feb. 21—Subject: The service of reconnaissance, including surveying, mapping and sketching, photography and map production. Speaker, Capt. Richard T. Coiner, Corps of Engineers.

Feb. 28—Subject: Field fortifications, sieges and demolitions. Speaker, Capt. Thomas M. Robins, Corps of Engineers.

March 6—Subject: Seacoast defenses and battle field illuminations. Speaker, Capt. Edward D. Ardery, Corps of Engineers.

March 13—Subject: The construction, maintenance and repair of roads, bridges and ferries; the selection and preparation of fords. Speaker, Capt. Thomas M. Robins, Corps of Engineers.

March 20—Subject: The selection, laying out and preparation of camps and cantonments; the service of general construction, and the special services, including all public work of an engineering nature which may be required in a territory under military control. Speaker, Capt. Richard T. Coiner, Corps of Engineers.

March 27—Subject: The construction, maintenance and operation of railways under military control, and the construction and operation of armored trains. Speaker, Capt. Thomas M. Robins, Corps of Engineers.

The organization committee in charge of this movement is composed of the following: J. Waldo Smith, chairman; Gano Dunn, chairman, Engineering Foundation; E. L. Corthell, president, and Charles Warren Hunt, secretary, American Society of Civil Engineers; W. L. Saunders, president, and Bradley Stoughton, secretary, American Institute of Mining Engineers; D. S. Jacobus, president, and Calvin W. Rice, secretary, American Society of Mechanical Engineers; J. J. Carty, president, and F. L. Hutchinson, secretary, American Institute of Electrical Engineers; Charles F. Rand, president, United Engineering Society. Other members of the committee are Richard S. Buck, J. Parke Channing, Alfred Craven, Thomas Crimmins, George Gibbs, Alexander C. Humphreys, John W. Lieb, William Barclay Parsons, George H. Pegram, Robert Ridgway, Merritt H. Smith, W. H. Wiley.

J. S. Langthorn, secretary of the committee, 250 West Fifty-fourth Street, New York City (telephone Circle 1676), will receive enrollments for the lectures.

The committee, in charge of the military lectures, is a purely voluntary organization and has no connection with the national societies' committee on the drafting of a bill for a proposed engineer officers' reserve corps. The latter body is headed by William Barclay Parsons and its other members are Henry S. Drinker, B. J. Arnold, W. H. Wiley and R. D. Mershon.

Patent Office Rules Revised

The revised general rules of practice before the U. S. Patent Office were approved by Secretary of the Interior Lane Dec. 22, and became effective Jan. 1. The revisions were made by a committee of which R. F. Whitehead, assistant commissioner of patents was chairman and Walter F. Rogers, former president of the Patent Bar Association was a member. The results of the committee's work were submitted to patents experts and attorneys throughout the country with the request that they give the Patent Office the benefit of their suggestions in respect to the proposed changes. Hundreds of suggestions were made, and many of them were incorporated in the new rules.

Record Sized Turbines Being Considered for New York Subways

Both the General Electric Company and the Westinghouse Electric & Manufacturing Company handed in bids and specifications on Wednesday of last week to Henry G. Stott of the Interborough Rapid Transit Company of New York City for two 60,000 kw. steam-turbine units. Each unit will be made up of three separate electric generators driven by one high-pressure and two low-pressure turbines, the latter being connected in multiple. These will be the largest steam turbines in the world, the next largest having been ordered from the General Electric Company recently by the Detroit Edison Company, and rated at 50,000 kva. No decision has been reached as yet on the choice of turbines, the Interborough Rapid Transit Company being undecided on single 60,000-kw. units or the equivalent in 30,000-kw. turbines.

Heaviest Snow in Thirty Years Descends on Cascade Mountains

The heaviest snow in thirty years was falling in the Cascade Mountains Feb. 2. Several buildings in Everett and Seattle, Wash., collapsed under the abnormal weight. Street railways and railroads were unable to cope with the storm and their services were badly crippled. The transcontinental lines abandoned the fight in the Cascades, where the snow was 19 ft. deep in places.

Three feet of snow fell within twenty-four hours in the blizzard that was at its height, Feb. 2, in Seattle and the Puget Sound District. Street railway and interurban service was paralyzed. All transcontinental lines had to give up the attempt to keep their lines open. Telegraphic communications were maintained under the greatest difficulties. St. James Cathedral in Seattle sustained damages to the extent of $150,000.

Montana Municipal Engineers Hold Annual Meeting

The Montana Institute of Municipal Engineers held its fourth annual meeting at Billings, Mont., Jan. 17, 18 and 19. Two and a half days were given to the reading of papers on street paving, improvement district laws, roads, water softening and purification, and sewage disposal and treatment. The afternoon of the third day was devoted to an inspection trip to the new filter plant at Billings.

The officers of the Institute elected for 1916 are as follows: President, Carl C. Widener, Bozeman; vice-president, C. W. Helmick, Helena; secretary-treasurer, John N. Edy, Billings; directors, M. L. Morris, and F. C. Snow.

Pennsylvania Proposes to Enlarge Baltimore Tunnel

A plan has been filed by the Pennsylvania Railroad with the city of Baltimore for the enlargement of the railroad's tunnel between the Union and Fulton stations in that city. No additional trackage is contemplated, but increased clearance for the existing tracks, together with better ventilation, is sought.

Seward Water System Sold

The water system at Seward, Alaska, was recently sold to Eastern capitalists, it is reported, for the sum of $200,000. The system was built by a Baltimore company at a cost of $75,000. Several water rights near Seward at a 200-ft. elevation above the town are included in the properties.

State Commissions Present Their Views on Federal Valuation of Railroads

Oppose Finding of Ultimate Value—Argue for Original Cost and Declare Reproduction Cost Discredited—Ridicule Railroads' Intangibles

Disagreement with the railroads was the common ground on which the various state public service commissions met at the valuation conference in Washington last week, called by the Interstate Commerce Commission to give the state commissions an opportunity to present their views on such fundamental questions as have arisen to date in the federal valuation of the carriers. The conference lasted two and one-half days, beginning Wednesday, Jan. 26. The discussion was based on the brief filed recently by the National Association of Railway Commissioners, those of four state commissions, California, Oregon, Kansas and Minnesota, and the answering brief of the carriers.

Except for two hours on the second day, when the carriers, through their four counsel, Pierce Butler, George S. Patterson, W. G. Brantley and Sanford Robinson, replied briefly to some of the states' arguments, the states had the floor throughout the conference. The spokesmen for the states were Max Thelen of California, A. E. Helm of Kansas, E. C. Niles of New Hampshire, C. B. Aitchison of Oregon, W. A. Shaw of Illinois, J. L. Bristow of Kansas and C. E. Elmquist of Minnesota.

States' Main Contentions

As summarized by Mr. Thelen at the close of the conference, the main contentions of the states were: (1) That the Valuation Act does not require an ultimate finding of value, but merely classified statements of the evidences of value; (2) that original cost to date must be found, estimates being made where exact figures are not available; (3) that reproduction cost new must be found on a rational basis (the states disagreeing with each other as to the rational basis, but agreeing that the carriers' basis is irrational); (4) that accrued depreciation must show in reproduction cost less depreciation; (5) that the reproduction cost of land cannot exceed the normal market value, and (6) that intangibles should be discussed further when the carriers have stated how they shall be valued. Among the other theories contributed by various of the other commissioners, but not subscribed to unanimously, may be mentioned the Minnesota theory of instantaneous reproduction, the Kansas contention that the railroads do not own their land, and the Oregon view that each appropriation from earnings for additions and betterments shall be allocated to the bits of work it covered—"where feasible."

Where Shall the Valuation Stop?

Three topics were discussed by Mr. Thelen at the opening of the conference. The first was the interpretation of the requirements of the Valuation Act. He objected vigorously to the railroad view that the Interstate Commerce Commission must find the ultimate value of the property. He held that the framers of the act had not sought to have the report show more than the elements or evidences of value, that value depended upon the purpose for which it was to be used, that value for rate-making purposes depended on much that no inventory could show, such as the value of the service, past earnings and many other elements, and that with no rate before it and no standard, which the Supreme Court must set, to measure the relative weights of even the known evidences of value, no value could be found.

Aids, gifts, grants and donations, the second subject assigned to Mr. Thelen, were discussed very briefly. His main contention was that all of the facts obtainable should be ascertained.

His third topic was intangibles. He held that the claims of the railroads to date under this head were wild and absurd, and thought, also, that the carriers would probably produce more as time passed. He asserted that they did not agree among themselves as to the definitions of these elements, and pointed out that they had not suggested how they were to be determined. He thought, consequently, that full discussion of them should be deferred until a later date. He took occasion to point out, however, that most of the decisions cited by the carriers at previous conferences in support of their intangibles were in other than rate cases. He asserted that unity of use, and location with respect to both operation and traffic, had been rejected by the courts, and that franchise value had been rejected except in the Willcox case. Speaking for California alone, he approved a restricted allowance for going value, taking into account the value of the service, allowing only a reasonable development period, and demanding reasonable judgment during the period.

Original and Reproduction Cost

Original cost to date and reproduction cost were the subjects assigned to Judge Helm. He prefaced his remarks, however, by an endorsement of Mr. Thelen's views as to the interpretation of the Valuation Act. He also gave voice to his misgivings as to the ability of the state commissions to compete with the organization of the carriers in the valuation work, which organization he thought was unnecessary and undesirable. These remarks were in accord with the Kansas brief, which argued that the carriers should remain silent until the presentation of a tentative valuation.

Taking up the question of original cost, Judge Helm deplored the efforts he thought the railroads had made to evade and conceal original cost. He held that whatever could not be found exactly by the records should be estimated. He contended that reproduction cost had been definitely rejected by the U. S. Supreme Court in the Minnesota rate case, that capitalization could not be the basis of value, and that original cost, therefore, was the only thing left, and all that should be considered. Like some of his confreres he thought reproduction cost was a useless figure, which would not have been called for if the Valuation Act had been passed after the handing down of the Minnesota decision.

Who Owns Railroad Land?

His discussion of reproduction cost was confined mainly to the item of land, in which he set forth the theory he had promulgated at the Philadelphia conference last November, that the railroad does not own its land, and that, whether the land was donated, acquired by condemnation or bought in fee simple, it must revert to the original owner if abandoned for railroad purposes. Commissioner Harlan of the federal board, possibly having in mind the man whose attorney told him he could not be put in jail, mentioned the fact that two terminals had been abandoned in the city of Washington, and that the land had been sold. This did not, however, cause Judge Helm to recede from his position as to the law.

To prove that the state commissions are right in their contention that accrued depreciation must be taken into account in reproduction cost less depreciation, Mr. Niles quoted from numerous decisions of the state commissions themselves. There appeared, however, to be much division of opinion, even in the decisions cited. In fact, as Mr. Brantley later pointed out, seemingly the main deduction to be derived was that the question of depreciation in the minds of courts and commissions is in a chaotic state.

Expenditures from Earnings

Mr. Aitchison argued for the detailed segregation of all expenditures for additions and betterments out of earnings or depreciation reserves, and for complete allocation of all details to the different states. Director Prouty asked whether the Division of Valuation must analyze the expenditure on each item of plant, to determine which parts were chargeable to other than capital, and also whether it was fair to credit Oregon with the full amount of an expenditure wholly in Oregon made from earnings in many states. Mr. Aitchison thought the allocation should be made "where feasible."

Mr. Shaw spoke on appreciation. He thought that subsidence, solidification and adaptation should in general not be allowed.

Senator Bristow spoke briefly on the question of whether or not the federal commission should report ultimate value. He held that to report this would be unfair to the framers of the Act, who, though disagreeing as to this ultimate value, had agreed to the desirability of assembling all the evidences of value.

Mr. Elmquist elaborated on the Minnesota theory of instantaneous reproduction, which takes into account only the so-called engineering reproduction of materials and labor, ignoring contingencies, interest and the like on the ground that there is no actual construction. This theory was commented on in the Engineering Record of Jan. 8, page 36.

The Railroads Reply

For the railroads Mr. Patterson insisted that they were in agreement with the states on many of the issues raised. He held that the carriers desired the recording of expenditures for additions and betterments made from earnings, surplus or depreciation reserves, and that they had never opposed the ascertaining of original cost, or relying within reason upon estimates. The carriers, he said, also recognize the importance of attaching the proper weights to the elements of value, and think this can await the completion of the inventories. Disagreeing with the Kansas view that they should remain silent until a tentative valuation has been presented by the Interstate Commerce Commission, he held that cooperation was imperative to prevent the duplication of large amounts of work.

Mr. Robinson commented on the fact that the state commissions had in the last year changed their views regarding overhead expenses in reproduction cost. He insisted that the Minnesota rate decision did not condemn reproduction cost, but only that particular presentation of it.

Depreciation Again

Speaking on appreciation and depreciation, Mr. Brantley mentioned, as previously stated, the diversity of views on the depreciation question even among the state commissions themselves, as revealed by the decisions read from Mr. Niles. He devoted himself mainly to the difficulty of applying mortality tables or any sort of theoretical treatment to such items of plant as equipment, the annual maintenance expense of which completely overshadows any depreciation reserve based on the original cost and probable life. He pointed out that the railroads had found it cheaper to rebuild an old car into a new type than to build new the identical new type, so that oftentimes little remained ultimately of the old car except the number. He cited the case of a locomotive which cost $3,350 new, and when retired after forty-seven years had cost $138,000 to maintain. In other words, the annual maintenance charge had averaged about $3,000, as against a theoretical depreciation reserve of $163. Obsolescence, he asserted, had usually been the cause of the ultimate retirement of equipment, but he held that no man could predict continued development and enlargement that would ever render present-day equipment obsolete.

Mr. Butler closed the railroad argument by disputing Judge Helm's assertion that the same restrictions applied to railroad land held in fee simple as to that acquired by condemnation, and by challenging the states to show any defect in the methods contended for by the railroads in their briefs for determining the reproduction cost of land.

California Theory of Land Reproduction

The main arguments made by Mr. Thelen in summing up the states' case were stated in the second paragraph. In addition he took up Mr. Butler's challenge regarding land. He held that the figures of recent actual costs to which the railroads invite attention include overhead, severance and improvement charges, together with an added item for continuity and suitability of shape, and that this makes the figure practically what the Supreme Court rejected in the Minnesota decision—far above the normal market value which, he holds, is definitely established by this decision to be the maximum allowable. He conceded that until fairly recently the California commission had tried to determine reproduction cost in the railroad manner, but that it had at last perceived the error of its ways, and was now proceeding according to its new definition of reproduction cost quoted in the Engineering Record of Jan. 15, page 76—the blending of *value* of land with *cost* of all other items.

Papers at Meeting of Illinois Engineers Run Whole Gamut of Engineering

Activated Sludge, Road Oiling, Rising Chemical Costs, Ethics for Engineers in Public Office, Drainage and Erosion Claim Attention

A multiplicity of papers and a paucity of discussion for lack of time marked the joint meeting of the Illinois Society of Engineers and Surveyors and the Illinois section of the American Waterworks Association, held at Urbana, Jan. 25 to 28.

Activated sludge elicited one of the most spirited discussions. The favorable cold weather findings at Milwaukee, as announced by T. Chalkley Hatton, seem to indicate that this new process has now been placed on a sound basis.

B. H. Piepmeier of the State Highway Department rather startled the more conservative engineers by his prediction that state aid for oiling 1000 miles of road, much of which has no metal surfacing, would be forthcoming this season. No earth road is oiled, however, with state assistance unless it has first been graded and rolled. To get this preliminary foundation for a surfaced road was his justification for the state paying for a dust preventive.

Waterworks operators were astonished and dismayed at the recent enormous jump in calcium hypochlorite quotations from 2½ to 13 cents per pound, pictured by W. F. Monfort on charts with curves brought up to the day previous to the meeting.

That soil erosion is an engineer's problem and one demanding early action was forcibly portrayed by Benjamin Brooks.

Much dissatisfaction has been expressed recently over the fact that many engineers holding public office are doing an undue amount of consulting work. A committee of the engineering society will look into the ethics of the situation and the fees charged.

Water Purification

Water softening in Illinois is coming more and more to the front, and four of the dozen papers scheduled dealt with this phase of water purification. The new plant at Hinsdale, a wealthy suburb of Chicago, was described and costs given by C. B. Williams, consulting engineer. It is the first municipal softening plant in the state.

F. C. Amsbary announced the successful use of an auxiliary wash-water grid above the sand surface in the iron removal filters of the Champaign & Urbana Water Company.

W. R. Gelston gave results of a year's operation of the new Quincy filters, reporting them according to the New England Waterworks Association recommendations. The lime and iron process, which made Quincy famous, will soon replace alum as a coagulant to keep costs within reason.

Water supplies on lake vessels have been examined during the past season by H. P. Letton of the U. S. Marine Hospital, Chicago. He analyzed 1000 samples from 74 passenger boats. About 22 per cent conformed to the standards set by the government for interstate carriers. So far only stills and heating apparatus have provided a safe water. Experiments on ultra-violet ray outfits are under way.

A typhoid outbreak at the Old Salem Chautauqua was described by H. F. Ferguson. The bad-example conditions are probably duplicated elsewhere and engineers were reminded that it is their duty to look more carefully into summer resorts. L. A. Fritze, of Moline, stated that 4-oz. bottles of hypochlorite with instructions as to use were furnished on demand to residents leaving the city for summer resorts.

Costs of producing alum by the process used at Columbus, Ohio, were given in a letter from George A. Johnson, general manager of the Hoover Chemical Company.

F. B. Seeley presented data on the flow of water through submerged short pipes having inlets and outlets of various angles of divergence. This information is of value to designers of short lengths like wall thimbles, intakes and suction pipes.

Sewage and Its Treatment

A. C. Stanfield described the new sewage treatment plant at Pana, Ill., which has cast-iron scalloped-edged distributing troughs 6 in. apart over the trickling filter.

Lake Forest has remodeled a fourteen-year-old septic tank into a double-compartment tank at small cost, according to N. N. Campbell.

Discussion of Mr. Hatton's paper on activated sludge and that of Prof. Bartow and F. Mohlman on the same subject brought out the fact that over treatment may reduce the sludge content to as much as 7 per cent.

W. D. Gerber in the report of the standing committee on sewerage and sewage disposal detailed the financial restrictions of the special assessment laws as applied to treatment works. In consequence, there is too little money spent for plants in the state. His report, with recommendation to support legislation enabling cities to get sufficient funds, was referred to the legislative committee.

Roads and Pavements

"Street Maintenance," a paper by J. E. Smith, contained a deserving plea for engineers to lend their aid to educate the public in the engineering of street maintenance, a problem being far out-shadowed, he held, by the call for the extension of country highways.

The committee on roads and pavements, of which B. H. Piepmeier is chairman, reported that thirty counties in the state were talking bond issues and that there was a good prospect of votes being taken in at least eight counties. A state-wide bond issue is also being agitated. About 100 miles of roads have now received state aid. Of these 98 per cent are of brick or concrete. Concrete with unarmored joints, 25 to 33 ft. apart, is becoming popular in small villages. Two-course work is dying out. Some hydrated lime is being used, but many investigations ought still to be made.

A description of the behavior of concrete pavement on Neil Street, in Champaign, by F. C. Lohman, gave a good idea of what will happen when things like frost, too rapid mixing, too much water and clay in the aggregate are not given proper attention.

Society Affairs

The newly elected officers of the waterworks section are as follows: Chairman, Paul Hansen; vice-chairman, E. MacDonald; trustee, W. E. Lautz; secretary, Edward Bartow, Urbana.

A one-day fall meeting will be held in Moline, arrangements to be perfected with the Iowa section, so that a combined evening session may be held, probably in Davenport.

The Illinois Society of Engineers is the new name the engineers adopted. A committee on structural engineering was added to the list of standing committees. The idea is to form a nucleus for a section for the structural men. An effort may be made to bring the state drainage association and a contemplated highway association into the society as sections.

Appointment of a representative on a national committee to draw up specifications for laying drain tile, suggested by the American Society for Testing Materials, was authorized.

The officers elected for the ensuing year are Paul Hansen, president; W. D. Gerber, vice-president; A. B. McDaniels and J. W. Dappert, trustees, and E. E. R. Tratman, secretary.

Next year's meeting will be held in Chicago, probably in the rooms of the Western Society of Engineers.

Ask Railroad Commission to Value Spring Valley Properties

A valuation of Spring Valley Water Company's properties, needed by the city of San Francisco for storage and distribution purposes in connection with the development of the Hetch Hetchy supply, will be undertaken by the California Railroad Commission, it is reported, under authority vested in the commission by a recent amendment to the public utilities act. The property considered necessary for city use will be examined by the commission, which will fix the valuation.

News of Engineering Societies

The New England Waterworks Association will hold a meeting at the Hotel Brunswick, Boston, Feb. 9.

The Engineers' Club of Atlantic City, which was organized recently, will be located temporarily in the Guarantee Trust Building. Willis Gale is secretary.

The North Dakota Society of Engineers will hold its annual convention at Grand Forks Feb. 24 and 25. E. F. Chandler of University, N. D., is secretary.

The Western Society of Engineers will be addressed Feb. 7 by Richard T. Fox, superintendent of the Chicago Citizens' Street Cleaning Bureau, on "Intensive Street Cleaning Methods."

The Arkansas Engineering Society will hold its annual convention at Helena Feb. 22-23. W. J. Parks of Pine Bluff, the secretary, is planning a trip through the "Sunk Land" district for the visitors.

The Boston Society of Civil Engineers, in conjunction with the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, will hold its annual banquet at the Boston City Club Feb. 8.

The Engineers' Club of Memphis elected the following officers at its annual meeting, held Jan. 12: President, C. K. Chapin; vice-president, A. L. Dabney; secretary-treasurer, C. C. Pashby; directors, H. N. Howe and J. H. Haylow.

The Southern California Association of Members of the American Society of Civil Engineers, Los Angeles, has elected the following officers for the ensuing year: William Mulholland, president; H. Hawgood, first vice-president; Louis C. Hill, second vice-president; W. K. Barnard, secretary, and Charles H. Lee as treasurer.

The Engineers' Society of Western Pennsylvania at Pittsburgh discussed "The Status of the Civil Engineer in the World and His Relation to Human Progress" at a meeting held Jan. 19. The following officers were installed: Samuel E. Duff, president; W. E. Snyder, vice-president; Dr. A. E. Frost, treasurer; H. D. Jones and W. E. Mott, directors.

The Mississippi Valley Terminal League will hold its second annual convention Feb. 16 at the Planters' Hotel in St. Louis. Prof. Julius Bonn, University of Munich, Germany, will speak on "International Trade." In the report of the secretary, C. F. Perry, Quincy, Ill., will be a tabulated statement of terminal work by various cities in the Mississippi Valley.

The Albany Society of Civil Engineers elected the following officers at its annual meeting, held in that city Jan. 25: President, Rupert Sturtevant; first vice-president; John E. Byron; second vice-president, Stephen B. Vernon; third vice-president, Roy G. Finch; secretary, Ernest G. Raynor; treasurer, Hortatio S. Mattimore; librarian, Wilber E. Anderson.

The Engineers and Architects' Association of Los Angeles held its annual dinner on Jan. 25 and elected the following officers: President, A. H. Koebig; first vice-president, Arthur S. Bent; second vice-president, Ira J. Francis; directors, H. L. Smith, J. J. Backus, George P. Robinson and A. C. Martin. Short talks were given by Samuel Storrow and A. B. Benton. A new organization known as the Engineers and Architects' Glee Club provided entertainment.

The Engineering Society of Wisconsin will hold its annual meeting at Madison Feb. 25 and 26. Special discussion is solicited on two topics, "Relation of Contractor and Engineer" and a paper by the mayor of Beloit on "Open Specifications." Some of the speakers who have promised papers are: A. C. Larson, chief engineer, Railroad Commission; F. G. Simmons, director public works, Milwaukee; W. F. Reichert, consulting engineer, Watertown; Prof. D. W. Mead; T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission. L. S. Smith, Madison, is secretary.

Personal Notes

WARREN A. LYON, formerly connected with the city engineer's office at Syracuse, N. Y., is now connected with the city engineer's office at Schenectady.

FRANK D. COONER has been appointed transitman in the office of the engineer maintenance-of-way of the Pennsylvania Railroad. He was graduated from Pennsylvania State College in 1909.

W. A. CATTELL, consulting engineer, of San Francisco, who has been in Honolulu appraising the properties of the Honolulu Rapid Transit & Land Company, has finished that work, and has been retained by the Oahu Railway & Land Company of Honolulu to make a valuation of its physical properties.

C. FRANK ALLEN, for the past 30 years a member of the faculty of Massachusetts Institute of Technology, will retire at the close of the present academic year. Professor Allen was graduated from the institute in 1872 and, for the next six years, was engaged in work connected with the water and sewerage systems of various cities, including Boston, Newton, Mass., and Providence, R. I. In 1878 he went West and, from that year until 1885, with the exception of a year spent as chief engineer of the Las Vegas, N. Mex., was assistant engineer of the Atchison, Topeka and Santa Fé Railway. In addition to his studies as an engineer he took up the study of the law and was admitted to the Bar in New Mexico in 1885, and in Massachusetts in 1901. He was appointed assistant professor of railway engineering at Massachusetts Institute of Technology in 1887. Two years later he became associate professor, and, since 1896, he has been professor, always in the department of civil engineering. He is the author of a number of technical writings, among them being: "Railway Curves and Embankments," "Tables for Earth Computations" and "Field and Office Tables," the first-named of which has passed through many editions.

FRANK V. SHERBURNE, formerly with the American Bridge Company at its Gary (Ind.) plant, has been appointed to a position on the engineering forces of the Worden-Allen Company, manufacturer of steel structures, of Milwaukee.

DAVID S. CARLL has retired from the office of general manager of the Capital Traction Company of Washington, D. C. He retains his office as vice-president, however, and will continue to serve on the board of directors.

BENJAMIN F. CRESSON, chief engineer of the New Jersey State Board of Commerce and Navigation, has notified Governor Fielder that the survey of the route of the proposed ship canal across the state from the Delaware, at Bordentown, to Morgan, on Raritan Bay, has been completed.

ROBERT GAW has been appointed town engineer of North Bergen, N. J.

E. W. SAYLES has been reappointed city engineer of Watertown, N. Y.

WILLIAM H. NORTH has been appointed city engineer of Bellingham, Wash.

G. W. BUCHHOLZ, formerly chief engineer of the Northeastern Construction Company, has joined the staff of the Snare & Triest Company, contracting engineers, 233 Broadway, New York City.

J. L. RICHMOND, general contractor, who recently completed his contracts on the New York State Barge Canal, has opened offices at Louisa, Ky., and will bid on work in the South and Middle West.

RAYMOND DUER, formerly county highway engineer of Des Moines County, Iowa, has been appointed highway engineer for Van Buren County, Iowa.

J. R. GRAHAM, superintendent of construction for James Kennedy, contractor, has been assigned to have charge of the construction of 29 miles of sanitary sewer for El Centro and Imperial, Cal., ranging in size from 8 in. to 33 in. The main sewer is for the purpose of taking the sewage from the two cities to about 6 miles north of Imperial and emptying it into the New River after it has passed through Imhoff tanks. About 8000 ft. of the work is in a 30-ft. cut, which will be excavated by steam shovel. Olmsted & Gillelen, consulting sanitary and hydraulic engineers, of Los Angeles, are engineers for the cities.

CHARLES E. BARBA, formerly assistant engineer in the office of the mechanical engineer of the Pennsylvania Railroad Company at Altoona, Pa., has accepted a position with the Midvale Steel Company.

H. W. BITTMAN has been appointed structural engineer for the school department of Seattle, Wash.

E. N. LAYFIELD, acting secretary of the Western Society of Engineers, was elected secretary of the new board of directors at its first meeting, Jan. 21. Previous to his present engagement, which began last spring, he maintained a consulting engineer's office, doing railroad work, for the last four years mainly with grade crossings and terminals at Chicago Heights, Houston, Tex., Chicago and Grand Rapids. Mr. Layfield entered the railway service in 1892 at the age of 20, being engaged in maintenance-of-way work and in charge of construction for the Pennsylvania between Philadelphia and Washington. From 1899 to 1911 he was with the Chicago Terminal Transfer Company, for six years being its chief engineer. In addition to his secretarial duties, he is president of the Board of Examiners of Structural Engineers for Illinois.

R. H. THOMSON, former city engineer of Seattle, has been named by the Aberdeen (Wash.) City Council as consulting engineer on the Wishkah water project, which is being considered by that city.

CHARLES S. HENNING has been appointed county engineer by the El Paso (Tex.) county commissioners. Mr. Henning commenced immediately checking up the grades and other preliminary work on the new county roads in Ysleta district.

FREDERIC ROBERT HARRIS, whose appointment as chief of the Bureau of Yards & Docks of the Navy Department was noted in these columns in the Jan. 22 issue, has been in the navy corps of civil engineers since 1903. His appointment, which entitles him to the title and privileges of a rear-admiral, makes him the youngest officer of that rank in the navy. His most conspicuous work in the service was the completion of the large drydock in the New York Navy Yard, after the Navy Department had seriously considered the abandonment of the project, due to the difficulties involved. In December, 1909, he was entrusted with special duty in charge of the construction of the dock. A few weeks later, after investigation, he urged upon the Navy Department the abandonment of the original design, and the adoption of a design which he proposed consisting of a comparatively shallow reinforced-concrete bottom, supported upon reinforced columns, which, in turn, were to act as anchors to resist flotation. The design was passed upon and approved for the contractors, Holbrook, Cabot & Rollins, Inc., by the late Alfred Noble. The drydock was in use for the docking of the U. S. S. Utah in May, 1912, which established a record for rapidity in construction. Admiral Harris was commended for this work by the Bureau of Yards & Docks and the Navy Department for "initiative, foresight and professional ability, conspicuous because of ingenuity and ability in conception of details, and energy in their execution." In 1913, he was entrusted with special duty by the Secretary of the Navy, and with Admiral Stanford, then chief of the bureau, he visited Pearl Harbor, Hawaii, to examine into the causes of the failure of the Pearl Harbor Drydock, then under construction. As a result he recommended the adoption of the method of construction involving the building in sections by sinking the floating caissons. Shortly thereafter the late Alfred Noble was engaged to visit Pearl Harbor. He indorsed the plan of construction proposed, and submitted two suggested developments of it. The plan now being followed was based on this method of construction on which patents were granted to Admiral Harris, but which was designed in detail by the Bureau of Yards & Docks and contains many ingenious and novel features.

Engineer, Who Completed New York Drydock, Appointed Chief of Navy's Bureau of Yards & Docks

Photo-Crafters, Phila.

FREDERIC ROBERT HARRIS

W. H. CUNNINGHAM, consulting engineer, of Huntington, W. Va., has moved his offices to the First National Bank Building in that city.

EDWARD B. RAIGUEL, formerly engaged in survey work at Huntington, W. Va., has joined the forces of W. H. Cunningham, consulting engineer, of that city.

RAY S. BLINN has resigned from the office of city engineer of Mount Vernon, Ohio, to become village manager of Westerville, Ohio. Mr. Blinn became city engineer of Mount Vernon five years ago, having succeeded Walter S. Anderson.

JULIUS ADLER, formerly engineer of tests of the city of Philadelphia, has been appointed engineer of tests for the Pennsylvania State Highway Department. A brief outline of Mr. Adler's professional history was published in these columns Jan. 8.

F. A. DUNHAM AND DAVID X. CLARIN have become associated under the firm name of F. A. Dunham-Clarin Company, Inc., 109 Park Avenue, Plainfield, N. J., to continue the civil engineering and surveying practice that has been conducted by Mr. Dunham for the past forty-two years. Mr. Clarin has been connected with Mr. Dunham for the past seven years. The firm specializes in surveys, municipal engineering, topography and city and county developments.

HARRY C. MCCLURE, formerly chief engineer in charge of design and construction for the department of architecture of the Board of Education of Toledo, Ohio, has been appointed city engineer of that city. Mr. McClure received degrees in civil engineering from the universities of Kansas and Michigan, and first engaged in engineering work in 1907 in the city engineer's office at Kansas City. Later he served as draftsman and instrumentman in the maintenance-of-way department of the Frisco Railway at Monett, Mo. In the early part of 1909 he was with Prof. W. C. Hood, then state sanitary engineer of Kansas. In June of that year he became connected with the Riggs & Sherman Company, consulting engineers, of Toledo, and was later detailed as inspector on the Toledo Shipbuilding Company's 100 x 700-ft. concrete drydock. He joined the forces of the Board of Education of the city in 1910 as assistant engineer on design and rose through various grades to the position of chief engineer. During the period he had charge of the structural design of schools to a value of $1,125,000 and of construction to a value of about $2,250,000.

ROBERT W. BOYD, consulting engineer, of New York City, has moved his offices to the Singer Building, 149 Broadway, New York City.

JOHN T. GEPHART, JR., has resigned as engineer of construction for the Pennsylvania State Highway Department to become consulting engineer of Fayette County, Pa. Mr. Gephart received his professional education at Western University of Pennsylvania and Pennsylvania State College. In 1901 he entered the construction department of the Pennsylvania Railroad in charge of surveys for the construction of the approaches to the Altoona gravity yard, one-half the low grade freight line over the Allegheny Mountains and the double track of the Petersburg Branch from Carlim to Petersburg. Later he was transferred to Lancaster in charge of the surveys and construction of the low grade freight line from Columbia to Shock's Mills, which position he was filling at the time he resigned to enter the State Highway Department as assistant engineer under Joseph W. Hunter, then state highway commissioner. In 1913 he was appointed construction engineer and was placed in charge of all construction work in the state. During the past summer, in the emergency created by a vacancy in district 5, Mr. Gephart assumed temporary charge of the district, meanwhile continuing his work as construction engineer. He continued in charge of the district until Jan. 1 of the present year.

Henry C. Vollmer, formerly city engineer of Burlington, Iowa, has been appointed city manager of Webster City, Iowa. Mr. Vollmer was graduated from the University of Iowa in 1908, and was engaged from then until 1910 in the office of the city engineer of Bozeman, Mont., and as county, bridge and drainage engineer of Grady County, Okla., at Chickasha. He was appointed city engineer of Burlington in April of the latter year.

B. L. Dorman has been reappointed city engineer of Vancouver, Wash.

C. L. Douthett, formerly assistant city engineer of Oelwein, Iowa, has been appointed assistant engineer for Vermilion County, Illinois, in connection with the bonded roads the county contemplates building. Mr. Douthett was graduated from Rose Polytechnic Institute in 1909.

Morse W. Rew has been appointed first assistant to Frank S. Krug, chief engineer of the Cincinnati Rapid Transit Commission. He will have charge of important branches of the construction work of the proposed new rapid transit loop for Cincinnati, particularly the building of the subway portion. Mr. Rew is a graduate of Massachusetts Institute of Technology, and was associated with Prof. George F. Swain in the construction of the Boston subway. Later he was connected with the building of the subways in New York City.

James W. Reagan, flood control engineer of Los Angeles County, California, has been appointed county engineer of that county. It will be his duty to carry out the preliminary work for the flood control project, for which a bond issue of approximately $3,600,000 will be submitted to the voters. Mr. Reagan has been serving the county under the title of flood control engineer, but, under the law creating the position, no provision was made for funds for office organizations and for preliminary work, although the position carried a salary. As flood control engineer he will receive a salary, and he will serve also as county engineer, but without salary. Under the new conditions funds are provided to carry on the necessary work preparatory to a bond election.

H. H. Barter, formerly director of works at the Panama-California Exposition, has been appointed head of the technical department of the Universal Film Manufacturing Company at Universal City, Cal. Mr. Barter received his professional education at the University of California, and was engaged for some time on railroad work in the State of Washington and in Alaska. Later he was connected with the Stone & Webster Engineering Corporation, of Boston, for a period of seven years, on the construction of steam and hydroelectric power plants. He left this service to go to the exposition work.

D. C. Sherman and L. J. Lichtenstetter have organized the firm of Lichtenstetter & Sherman, James Building, Chattanooga, Tenn., to engage in business as engineers and sales agents for structural steel, fireproofing, tanks, etc.

George Hogarth, formerly assistant engineer of the Department of Public Works of Ontario, Canada, has been appointed chief engineer of the Department of Highways of that province.

Otis F. Clapp resigned from the office of first assistant to the city engineer of Providence, R. I., Feb. 1, after fifty years in the city's service. As a member of the force of Shedd & Edson, consulting engineers, of Boston, Mr. Clapp went to Providence in 1866, in charge of a party on the preliminary surveys for the municipal waterworks then projected in that city. In 1872 he was placed in charge of the preparation of plans for the sewage disposal system, and in 1897, he succeeded the late J. Herbert Shedd as city engineer. He held this post until the spring of last year when he was replaced and appointed first assistant to the city engineer.

H. K. Barrows and C. B. Breed have dissolved the partnership heretofore existing under the name of Barrows & Breed, consulting engineers, of Boston. They will continue to occupy joint offices, however, at 6 Beacon Street, Boston. Mr. Barrows will continue in practice as consulting hydraulic engineer, giving special attention to water power, water supply and sewerage. Mr. Breed will continue practicing as consulting engineer, specializing in railroad, structural and municipal projects.

Charles E. Jenkins, formerly engineer maintenance-of-way of the Easton Transit Company, of Easton, Pa., has been appointed chief engineer of the Lehigh Valley Transit Company, succeeding W. W. Wysor. Mr. Jenkins first engaged in engineering work in 1896 as chainman for the town engineer of Franklin, N. J. From 1898 to 1903 he was with various consulting engineers. In the latter year he was appointed a transitman on the Long Island Railroad in which position he remained until 1904 when he became assistant city engineer of Easton, Pa. He later entered the service of the Easton Transit Company and, in 1908, was appointed engineer of ways and structures.

Joseph M. Tracy, formerly assistant city engineer of Ogden, Utah, has been appointed city engineer, succeeding Washington Jenkins. The position of assistant city engineer has been abolished.

Stacy S. Rumpleton, consulting engineer, of Binghamton, N. Y., has been appointed municipal engineer of Johnson City, N. Y.

H. S. Everhart, formerly junior partner of N. L. Everhart & Son, architects and contractors, of Greenfield, Ohio, is at present connected with the Kansas City Structural Steel Company.

Revoe C. Briggs has resigned from the U. S. Coast and Geodetic Survey to take up graduate work in the engineering department of Stanford University. He will also serve as field assistant in the department.

F. C. Clark has resigned from his position as superintendent of the Pacific Locks of the Panama Canal.

S. M. Morse has been appointed assistant engineer for the Commonwealth Mining & Milling Company at Pearce, Ariz.

H. B. Miller, consulting mining engineer and geologist, of Pittsburgh, is engaged in the prospecting of two tracts of coal near Grove City, Pa. The seam is 3 or 4 ft. in thickness, and has an overburden, or cover, of from 15 to 45 ft. If the investigation shows that such development is warranted, it is proposed to open up stripping operations and remove the overburden either with steam or electric shovels. It is believed that this is the only stripping territory in western Pennsylvania.

John Le Tourneux has resigned from the office of city engineer of Neenah, Wis.

Henry H. Quimby has been reappointed chief engineer of the Department of City Transit of Philadelphia.

Carl S. Donaldson has been reappointed city engineer of Beaver Falls, Pa.

J. M. Meade has been appointed special engineer for the Atchison, Topeka & Santa Fé Railway at Topeka, Kan.

Hugo Shaefer, formerly master mechanic of the Pecos division of the Atchison, Topeka & Santa Fé Railway, has been appointed pilot engineer in the valuation department.

N. B. Walkem, formerly resident engineer of the Canadian Pacific Railway at Nelson, B. C., has been appointed assistant engineer, and attached to the division engineer's office at Vancouver.

H. G. Barber, formerly assistant engineer on the construction of Rogers Pass tunnel, has been appointed resident engineer for the Canadian Pacific at Nelson, B. C.

S. M. Cotten, formerly connected with the office of the chief engineer of the Arizona Eastern Railroad on revaluation work at Tucson, Ariz., has been appointed to a position in the newly organized valuation department of the Texas & Pacific Railway at Dallas, Tex. Mr. Cotten received his professional education at the Agricultural and Mechanical College of Texas, and has been engaged in active practice since 1909, principally on railroad and reclamation work.

C. J. Callahan, formerly with the New York State Public Service Commission, First District, has been appointed construction engineer on the forces of John T. Scully, Inc., contractors, of Boston, Mass.

Obituary Notes

Matthew Gage, builder of the Gage canal and irrigation system which waters one of the choicest orange districts in California, near Arlington, died at Riverside, Jan. 22. He was born in 1844 and went to Southern California in 1881. The country where Riverside and Arlington now stand was then practically a desert. Foreseeing the possibilities of irrigation, Mr. Gage set out to develop water. With little money he bought up old water rights on the Santa Ana River, purchased a tract of land below his source of supply, sank artesian wells and began the construction of a canal system. Within one year he had completed the first 12 miles, and, eventually, all of it without the sale of stock or land. With the idea of interesting capitalists in further development he organized the Riverside Trust Company. This resulted in the laying out of Arlington Heights, and the planting of orange groves now valued in millions.

Frank D. Gould, senior partner of Gould & Sons, general contractors, of Omaha, Neb., died Jan. 24. He was sixty-two years old.

W. H. Davis, superintendent of repairs in the highway department of Jacksonville, Fla., died in that city, Jan. 26.

William B. Ruggles, head of the Ruggles-Coles Engineering Company, of New York City, died at Bergen Point, N. J., Jan. 23. Mr. Ruggles received his education at Cornell University, and was, for more than twenty years, engaged in engineering work in New York City. Recently he was engaged as engineering adviser to the Russian Government. He was fifty-four years old.

William W. Mills, retired civil engineer, who was identified with the building of the original New York City subways, died, at Pasadena, Cal., Jan. 25. He was seventy years old.

Frank M. Baker, formerly a member of the New York State Railroad Commission, died at Owego, N. Y., Jan. 22.

Griffith D. Walters, chief agricultural engineer of the Irrigation Branch, Canadian Department of the Interior, died in Calgary, Alberta, after a brief illness. Mr. Walters was born in Wales in 1884. He received the degree of B. S. in civil and irrigation engineering in the Colorado Agricultural College in 1911, and, during the following year, was assistant in irrigation investigations there, under V. M. Cone. In 1913 he was engaged to take charge of the duty of water investigations for the Canadian Government under F. H. Peters, commissioner of irrigation. He was, at the time of his death, chief agricultural engineer, Irrigation Branch, Department of the Interior.